THE OHIO JOURNAL OF SCIENCE

VOL. XLII JULY, 1942 No. 4

ANNUAL REPORT OF THE OHIO ACADEMY OF SCIENCE 1942

THE OHIO ACADEMY OF SCIENCE

Organized 1891 Incorporated 1892

Affiliated with the American Association for the Advancement of Science

OFFICERS AND COMMITTEES FOR 1941–1942

President

FREDERICK H. KRECKER

Vice-Presidents

A. *Zoology:* ROBERT M. GEIST
B. *Botany:* CONSTANTINE J. ALEXOPOULOS
C. *Geology:* KENNETH E. CASTER
D. *Medical Sciences:* S. W. CHASE
E. *Psychology:* L. D. HARTSON
F. *Physics and Astronomy:* R. L. EDWARDS
G. *Geography:* REUEL B. FROST
H. *Chemistry:* R. G. HOOD
I. *Mathematics:* R. C. HILDNER
J. *Junior Academy:* PHILIP DYE
K. *Anthropology:* H. C. SHETRONE

Secretary

ARTHUR W. LINDSEY

Treasurer

CLARENCE E. TAFT

Historian

WILLIAM H. ALEXANDER

Executive Committee

Ex-Officio: F. H. KRECKER, A. W. LINDSEY AND C. E. TAFT
Elective: EUGENE VAN CLEEF AND G. W. BLAYDES

Trustees of the Research Fund

PAUL B. SEARS, term expires.....1943
HERBERT OSBORN, *Chairman*, term expires.....1944
F. C. BLAKE, term expires.....1945

Library Committee

MRS. ETHEL M. MILLER, *Chairman*

Librarian in charge of Academy Exchanges and Publications

FRANCIS E. RAY, term expires.....1943
WARREN P. SPENCER, term expires.....1944

Committee on Conservation

T. H. Langlois, *Chairman*, term expires.....1943
Dwight M. DeLong, term expires.....1943
J. D. Sayre, term expires.....1943
G. W. Conrey, term expires.....1944
Paul B. Sears, term expires.....1944
E. L. Wickliff, term expires.....1944
E. Lucy Braun, term expires.....1945
E. S. Thomas, term expires.....1945
Wilber Stout, term expires.....1945

Committee on Nominations for 1943

The Vice-Presidents of 1941–42—J. Paul Visscher, *Chairman*

Membership Committee for 1943

A. *Zoology:* H. R. Eggleston
B. *Botany:* Freeman S. Howlett
C. *Geology:* John W. Wells
D. *Medical Sciences:* E. W. E. Schear, *Chairman*
E. *Psychology:* A. C. Anderson
F. *Physics and Astronomy:* E. H. Johnson
G. *Geography:* Karl Ver Steeg
H. *Chemistry:* Roy I. Grady
I. *Mathematics:* R. E. Manchester
J. *Junior Academy:* J. W. Branson
K. *Anthropology:* William Lipkind

Academy Representatives

1. On the Joint Administrative Board, *O. J. S.:* Francis E. Ray, term expires 1943, and Warren P. Spencer, term expires 1944.
2. On the Council of the A. A. A. S.: A. W. Lindsey.
3. On Save Outdoor Ohio Council: Roscoe W. Franks.

The Council for 1942–1943

Alexopoulos, Constantine J.
Anderson, A. C.
Blaydes, G. W.
Branson, J. W.
Caster, Kenneth E.
Chase, S. W.
Dye, Philip
Edwards, R. L.
Eggleston, H. R.
Frost, Reuel B.
Geist, Robert M.
Grady, Roy I.
Hartson, L. D.
Holdner, R. C.
Hood, R. G.
Howlett, Freeman S.
Johnson, E. H.
Krecker, F. H.
Langlois, T. H.
Lindsey, A. W.
Lipkind, William
Manchester, R. E.
Miller, John A.
Osborn, Herbert
Ray, Francis E.
Schear, E. W. E.
Shetrone, H. C.
Spencer, Warren P.
Taft, C. E.
Van Cleef, Eugene
Ver Steeg, Karl
Wells, John W.
Williams, S. H.

REPORT OF THE FIFTY-SECOND ANNUAL MEETING OF THE OHIO ACADEMY OF SCIENCE

The fifty-second meeting of the Academy took place in Granville on April 16, 17 and 18, 1942. Although the date was originally set as the first weekend in May and was changed to avoid conflict with the Baltimore meeting of the American Physical Society, the change was very probably an advantage, for the weather was perfect. The Academy had not met in Granville for twenty-nine years. In that period it had grown beyond the capacity of the available accommodations, but the addition of the new Life Science Building to the Denison University campus provided ample rooms for all sectional meetings this year.

The session opened with the annual meeting of the Executive Council at 3:30 P. M., April 16. This meeting is reported on another page.

Thursday evening the Academy presented Mr. Karl Maslowski, of Cincinnati, in his illustrated lecture, *From Seashore to Glacier with a Naturalist.* Mr. Maslowski's genial personality and superlative motion pictures in color provided an evening's entertainment that has brought many expressions of enthusiastic appreciation from his capacity audience.

Friday, April 17, was given over wholly to sectional meetings and the annual banquet and business meeting. With the exception of the Physics section and the Junior Academy, which met on the following day, each of the nine remaining sections met for one or for both morning and afternoon sessions. In general the attendance was large.

The newly formed Section K, Anthropology, with an initial membership of 17, also joined the Academy on this occasion. Their enthusiasm deserves the congratulations and good wishes of our entire membership as we welcome them into our organization.

The ladies of Denison University received the ladies of the Academy at tea in Curtis Hall during the late afternoon, and the perfect spring day led many members to spend their spare time out of doors. It is difficult for a secretary who is also connected with the host institution to express himself properly on the occasion. From the many complimentary remarks that have come in, Academy visitors evidently found the day most enjoyable, and from the Secretary's local role he can testify that no visitor could have been more pleased than the committee on arrangements that the campus and the weather did their part so well!

The banquet was served in the Granville Inn to a group of approximately 150. Dr. W. C. Ebaugh, chairman of the Local Committee on arrangements, presided as toastmaster. Following the banquet President Kenneth Irving Brown of Denison spoke briefly in welcome. His remarks on the budget items requested by scientists brought a hilarious moment into the meeting, along with a serious reminder of the opportunities that scientists enjoy in their teaching. Dr. George B. Barbour, Dean of McMicken College of Liberal Arts of the University of Cincinnati, responded in kind for the Academy, demonstrating brilliantly that scientists need not be only scientists but may be versatile scholars as well.

The program concluded with the address of President Eugene Van Cleef of the Academy on *The City of the Future,* in which an interesting picture was painted of the effects of air transportation and commercial needs on city planning in times to come.

In the brief business meeting following the banquet the proposed changes in the Constitution, approved by the Council, were ratified by the Academy. In lieu of a report of the Committee on Necrology, which had just been appointed, the Secretary read the names of members who had passed away during the year. These names were referred to the Committee for their action.

The report from the Council, presented by the Secretary, showed the addition of 26 new members. The twenty-two members listed below were elected to fellowship:

Angerer, Clifford A.
Burgess, Wayland M.
Chase, John H.
Chittum, John W.
Detweiler, Frederick G.
Dustheimer, O. L.
Edgerton, Harold A.
Garber, Harold J.
Hildner, Richard C.
Hoerr, Normand L.
Ireland, H. A.
Lawrence, William E.
Mahr, August C.
Manchester, R. E.
McBryde, Felix W.
Morgan, Richard G.
Osborn, Clinton M.
Palmer, Dwight M.
Ring, Gordon C.
Roos, Frank J., Jr.
Tipton, S. R.
Williamson, C. O.

Dr. J. Paul Visscher presented the report of the Committee on Resolutions, and after a vote of approval the meeting adjourned.

Respectfully submitted,

A. W. Lindsey, *Secretary.*

REPORT OF THE TREASURER

COLUMBUS, OHIO, May 17, 1942.

To the Ohio Academy of Science:

I submit herewith a financial statement of the condition of the Ohio Academy of Science as of December 31, 1941. The books have been audited and the opinion of the auditor is herewith attached.

Respectfully submitted,

EDWARD S. THOMAS, *Treasurer.*

EXHIBIT A

OHIO ACADEMY OF SCIENCE BALANCE SHEET AS AT DECEMBER 31, 1941

ASSETS

CURRENT EXPENSE FUND:		
Cash in Bank—Current		$ 262.43
Total Dues Receivable		577.50
Interest Receivable (Bond Coupons not cashed 1941)		39.00
Bonds—Consolidated Federal Farm Loan 3% 1945–55		1,300.00
Total Assets—Current Expense Fund		$2,178.93
RESEARCH FUND:		
Cash in Bank	$ 210.53	
Banc-Ohio Securities Company Stock (cost)	437.50	
Bonds—Fort Hayes Hotel, Columbus, Ohio (cost)	1,300.00	
Total Assets—Research Fund		1,948.03
TOTAL ASSETS		$4,126.96

LIABILITIES, DEFERRED CREDITS AND NET WORTH

LIABILITIES:		
Accounts Payable		$ 234.25
DEFERRED CREDITS TO INCOME:		
Reserve for Uncollected Dues, 1939, 1940, 1941	$ 577.50	
1942 Dues Collected in 1941	29.00	
Total Deferred Credits to Income		$ 606.50
Total Liabilities and Deferred Credits		$ 840.75
NET WORTH:		
Ohio Academy of Science:		
Current Expense Fund—Surplus	$1,338.18	
Research Fund—Surplus	1,948.03	
Total Net Worth		3,286.21
TOTAL LIABILITIES, DEFERRED CREDITS AND NET WORTH		$4,126.96

EXHIBIT B

Ohio Academy of Science Statement of Income and Expense

Current Expense Fund

For the year ending December 31, 1941

Income:		
Dues for the year 1941		$1,262.50
Grants for Research		175.00
Sale of Publications		18.93
Interest on Bonds		39.00
Junior Membership Contribution		15.00
Total Income		$1,510.43
Operating Expenses:		
Clerical Assistance	$ 29.83	
Postage and Telegraph	57.70	
Office Supplies and Expenses	9.00	
Expenses of Officers to meetings	53.87	
Printing:		
Proceedings—Ohio Journal of Science	108.25	
Other	314.09	
Subscriptions to Ohio Journal of Science	861.00	
Research Grants	175.00	
Secretary's Honorarium	100.00	
Safety Deposit Box Rent	3.33	
Bond—Treasurer	5.00	
Auditing Expense	15.00	
Bank Charges	2.23	
Reporting Proceedings Annual Meeting	20.00	
Total Operating Expenses		$1,754.30
Net Operating Deficit		*$ 243.87*
Other Income:		
Total Dues for Prior Years		$ 192.50
Net Loss for the year		*$ 51.37*

EXHIBIT C

Ohio Academy of Science Statement of Cash Receipts and Disbursements

For the year ending December 31, 1940

Cash Balance—December 31, 1940:		
Current Expense Fund		$ 233.55
Semi-Centennial Celebration		596.10
Total Cash Balance—December 31, 1940		$ 829.65
Deposits for the Year:		
Dues, 1941	$1,242.50	
Dues, 1940	172.50	
Dues, 1939	20.00	
Dues, 1942	29.00	
Research Grants	175.00	
Federal Farm Loan Interest Coupons	39.00	
Sale of Publications	18.93	
Junior Membership Contribution	15.00	
Total Deposits—Ohio Academy of Science	$1,711.93	
Semi-Centennial Celebration, 1941	50.00	
Total Deposits		1,761.93
Total Cash to be Accounted for		$2,591.58
Disbursements (Checks Written):		
Ohio Academy of Science:		
Accounts Payable	$ 163.00	
Clerical Assistance	29.83	
Postage and Telegraph	57.70	
Office Supplies and Expense	9.00	
Expenses of Officers to Meetings	53.87	
Printing	314.09	
Subscriptions—Ohio Journal of Science	750.00	
Research Grants	175.00	
Secretary's Honorarium	100.00	
Safety Deposit Box	3.33	
Bond for Treasurer	5.00	
Bank Charges	2.23	
Reporting Proceedings, Annual Meeting	20.00	
Total—Ohio Academy of Science	$1,683.05	
Semi-Centennial:		
Accounts Payable	$ 97.58	
John A. Miller, Ohio Journal of Science	548.52	
Total Semi-Centennial	646.10	
Total Disbursements		$2,329.15
Cash Balance, December 31, 1941—Ohio Academy of Science		$ 262.43

AUDITOR'S CERTIFICATE

COLUMBUS, OHIO, July 1, 1942.

The Ohio Academy of Science, Columbus, Ohio.

GENTLEMEN: In accordance with your instructions, I have audited the accounts and records of the Treasurer of the Ohio Academy of Science for the year ended December 31, 1941.

Cash in the bank was verified by bank confirmation and reconcilement with book balance. All cash receipts and disbursements of the current expense fund were checked in detail for the period under review.

Investment securities on hand December 31, 1941, in the current expense fund were examined and found to be as stated in the accompanying balance sheet.

Cash and investment securities of the research fund were not examined or verified in the course of this examination.

The records and accounts of the Treasurer were found to be in excellent condition and well kept.

I hereby certify that, in my opinion, the accompanying Balance Sheet as at December 31, 1941, and related statement of income and expense fairly present the financial condition of the Ohio Academy of Science and the results of operation for the year ended that date.

Respectfully yours,
D. M. SHONTING, *Certified Public Accountant.*

REPORT OF TRUSTEES OF THE RESEARCH FUND

The accounts of the Research Fund for the year 1941 and submitted for audit as of December 31, 1941, were as follows:

CREDITS

Balance January 1, 1941	$ 87.16
Deposits during 1941	124.50
Total Credits	$ 211.66

DEBITS

Service Charges at Bank	$ 1.13
Total Debits	$ 1.13
Balance in Checking Account January 1, 1942	$ 210.53
The Invested Funds are the same as a year ago.	
Bonds (at cost)	$1,300.00
Stocks, Ohio National Bank (at cost)	437.50
Total	$1,737.50
Cash Balance in Checking Account	210.53
Total	$1,948.03

Later additions and anticipated income for the current year will give us a free balance of over $200.00 and applications for grants during the current year will be welcomed.

The grant from A. A. A. S. for research is $157.00 for the present year and this will permit an allowance for research projects in progress. Allowance from the A. A. A. S. is likely to continue and it would seem that we may anticipate grants of at least $250.00 each year. It is expected that all of the allowance from the A. A. A. S. will be expended during each year.*

Respectfully submitted,
HERBERT OSBORN,
PAUL B. SEARS.

*The grant from the American Association for the Advancement of Science for 1941 was allotted to Doctors Wolfe, Wareham and Scofield, of the Department of Botany, O. S. U., to assist in their ecological studies at "Neotoma" in Hocking County.—H. O.

JUNIOR SECTION—OHIO ACADEMY OF SCIENCE

FINANCIAL REPORT

For the Year Ended December 31, 1941

RECEIPTS

Adult and Student Fees	$ 99.80
Contributions—Senior Academy	34.20
Total	$134.00

DISBURSEMENTS

Senior Academy	$15.00	
Clerical Assistance	4.83	
Postage and Telegraph	27.39	
Office Supplies and Expense	8.85	
Printing	12.06	
Awards	61.36	
Miscellaneous	3.95	
		133.44
Cash Balance December 31, 1941		$ .56

Respectfully submitted,

P. L. LINEBRINK, *Sec.-Treas.*,
Junior Academy Section.

REPORT OF THE EXECUTIVE COMMITTEE AND COUNCIL

The Executive Committee of the Academy held one meeting in Columbus on November 29, 1941, with the full membership in attendance. At this meeting the invitation of Denison University to hold the annual meeting of the Academy in Granville was received and accepted. Plans for this meeting were discussed, and the general arrangement of the program was worked out.

Dr. Van Cleef presented his proposal for a radio program, which was approved by the Committee.

The Committee spent a considerable amount of time disposing of items of routine business that need not be reported here in detail. Two important matters considered were the formation of a new Anthropology Section and Dr. Evans' suggestion of a commemorative tablet for the fiftieth anniversary. The formation of the new section proved to be hampered by the constitutional requirement of twenty-five members. Since a change in this minimum would necessitate an amendment, the committee voted that the group interested in Anthropology be invited to meet with the Academy in the spring, when the action necessary for their official organization could be taken.

Dr. Evans' suggestion of a commemorative tablet brought out an offer from Dr. Rothemund for the bronze foundry at Antioch to handle the work. Orton Hall on the Ohio State University campus was proposed as a fitting place for the tablet, and methods of financing were discussed. The whole project was approved by the committee and left in Dr. Evans' hands for the arrangement of details.

The committee also voted to offer the services of the Academy in the national emergency to Governor Bricker.

The first meeting of the Council was held in Columbus on January 17, 1942, with twenty of the thirty members present. Much of the meeting was devoted to routine business with which Academy members have already been made familiar, including such items as the election of new members and fellows and the approval of items recorded above from the meeting of the Executive Committee.

The office of Historian, suggested by the Nominating Committee at Cleveland in 1941, was approved, and the presentation of an amendment to the constitution for its creation was authorized. Other amendments provided for at this time and duly placed in the hands of the

Secretary in satisfaction of the constitutional requirements proposed the addition of the editor and business manager of the *O. J. S.* to the Council, the election by each section of a membership committeeman only, this officer to become vice-president of his section for the succeeding year, and the reduction of the minimum membership requirement of new sections from twenty-five to ten.

Measures to increase the income of the Academy were also discussed at this meeting. A particularly significant item was the suggestion of institutional membership. The proposal was left in an indefinite state, but seems worthy of more careful study and future action, particularly to augment the research funds available to the scientists of Ohio.

The final, or annual meeting of the Council, held in Granville on April 16, 1942, was devoted largely to the presentation of the reports printed herewith. The vexed question of publication costs and of the publication of abstracts occasioned long discussion in connection with Dr. Miller's report on the *O. J. S.* For the present, the question of abstracts was left to the Editor's judgment.

Reports from Messrs. Waller and Franks brought out some impressive facts concerning the part played by the Academy in Ohio conservation. Due to changes arising from the shift of national interests the Council felt very strongly that the Academy should assume responsibility for further long-range planning in this field as one of the greatest fields of public service open to it.

Items of routine business taken up by the Council at this meeting have already come before the members of the Academy either for their approval, in reports, or in arrangements for the annual meeting.

The amendments to the Constitution proposed at the time of the last meeting were approved by the Council and later by the Academy in the annual business meeting. They are summarized as follows:

At the Annual Meeting on April 18 the Academy adopted amendments to the Constitution on which the following changes are based:

Article IV, Section 2. Substitute the following for the old paragraph a:

(a) The Council shall be composed of the President, Secretary and Treasurer of the Academy, the two most recent Past Presidents, the Chairman of the Trustees of the Research Fund, the Chairman of the Committee on Conservation, the Academy Representatives on the Joint Administrative Board and the Editor and Business Manager of the *Ohio Journal of Science*, the Vice-President and the Membership Committeeman of each organized Section as provided for in Article IV, Section 7 (e) and Article VIII, Section 2 (b), and at intervals the retiring Secretary.

Article IV. Insert the following section after Section 3 and raise the numbers of former Sections 4 to 7 to correspond:

4. *Historian.*—The Academy Historian shall gather and preserve material pertaining to the history of the Academy.

In Section 7, paragraphs c and e, insert Historian after Librarian.

Article IV, Section 7. Substitute the following for the old paragraph d:

(d) Members of the Membership Committee, one from each Section, shall be elected annually by the Sections. The President shall designate the Chairman of the Membership and Nominating Committees.

Article VI, Section 2. Substitute the following for the old paragraph b:

(b) Each regularly organized Section of the Academy shall elect by ballot its representative on the Membership Committee, who shall be a Fellow. This member in the following year shall become the vice-president of his section. The President shall then designate the chairman of the Membership and Nominating Committees. See Article IV, Section 5 (b).

Article VIII, Section 1, line 1: change twenty-five to ten.

Respectfully submitted,

A. W. LINDSEY, *Secretary.*

REPORT OF THE JOINT ADMINISTRATIVE BOARD OF THE OHIO JOURNAL OF SCIENCE

COLUMBUS, OHIO, April 4, 1942.

To the Ohio Academy of Science:

The only meeting of the Joint Administrative Board of the *Ohio Journal of Science*, since last reported to the Academy, was held at The Ohio State University April 4, 1942. Present were Chairman Patrick, and Drs. Ray, White, Snyder, Blaydes and Miller. The meeting was called to order by Chairman Patrick at 12:30 P. M. The minutes of the preceding meeting were read and approved.

The Report of the Editor is as follows:

The Editor's report given by Dr. Blaydes included a summary of the manuscripts on hand. There are a sufficient number to insure a complete and varied complement for the next 12 to 14 months. Dr. Blaydes explained the change in format with a resulting economy of space without materially reducing the number of words per issue. The editor made an appeal for special papers of general interest. Mention was made of several special papers now on hand to appear in the near future.

The following motion was presented by Dr. Ray and seconded by Dr. Patrick: "The Joint Administrative Board reports to the Council that a section of the *Journal* be devoted to the publishing of papers, from time to time, summarizing current practical problems of scientific interest. That members of the Academy be asked to suggest to the editor topics of such general interest and recommend individuals that are in a position to submit the same." The motion was carried.

Dr. Blaydes recommended that a revision of the Associate Editorial Staff be made. The editor further recommends that Dr. Geo. M. Curtis of the Department of Medical Research be added to the staff in the field of Medical Science.

Chairman Patrick appointed Drs. Snyder and Blaydes as a committee on reorganization of the Editorial Staff. This committee was charged with the duty of bringing a closer association between the sections of the Academy and the associate editors.

The report of the editor was accepted.

The report of the business manager is as follows:

The business manager's report as given by Dr. Miller included several matters of both urgent and routine business. The financial report follows:

FOR THE FISCAL YEAR 1941

RECEIPTS

Balance from 1940	$ 67.36
University Allowance	750.00
Ohio Academy of Science—pro rata of Dues	750.00
Ohio Academy of Science—Semi-Centennial	498.52
Sigma Xi	200.00
Ohio Academy of Science—Proceedings	108.25
Ohio Academy of Science	50.00
Subscriptions	98.50
Sale of Back Numbers	19.40
Authors' Payments for Plates	105.95
Payment by Author of Publication Costs	103.17
	$2,751.15

EXPENDITURES

Spahr and Glenn Co., Printing Vol. 41 and Envelopes and Stationery	$2,050.05
Bucher Engraving Company	435.28
Postmaster	78.88
Bank Charges	.51
	$2,564.72
Balance on Hand, February 16, 1941 (Huntington National Bank)	186.43
	$2,751.15

Cost of Special Numbers

Cost of Printing Semi-Centennial Number	$ 696.05
Engraving	161.42
Mailing	25.38
Total Cost of Semi-Centennial Number	$ 882.85
Cost of Printing Historical Number	268.70
Engraving	60.44
Total Cost for Historical Number	$ 329.14
Total Cost of Semi-Centennial Number	882.85
Total Cost Paid by Journal for above numbers	$1,211.99
Less $498.52 from the Semi-Centennial Printing Fund	498.52
Less $200.00 Sigma Xi Contribution	200.00
Amount Paid by Journal toward the Publication of these two Academy numbers	$ 513.47

It was recommended that it be pointed out to the Council and the Academy that the amount of money paid out of the *Journal* funds for the publication of the Semi-Centennial Number and the Historical Number was $513.47.

The business manager presented to the board for consideration a communication from the office of censorship, Washington, D. C. The licensing system outlined in this communication was discussed, terminating in the following actions. A motion by Dr. White and seconded by Dr. Snyder is as follows:

"The matter of *Journal* going to foreign countries be placed in the hands of the Editor and Business Manager, with specific powers granted to withhold sending of said *Journals* until censorship rules shall be lifted." Motion carried.

The Board instructed the Business Manager to write to all foreign subscribers and exchanges stating that their copy of the *Journal* was being held for them and requesting them if possible to continue sending their *Journals*.

Upon a statement from Spahr and Glenn, publishers, that henceforth the cost of reprints will be advanced 10%, the Board instructed that this increase be noted on all future quotations.

Drs. Snyder and White were appointed as the auditing committee.

The Business Manager presented to the board the problems arising from the increased cost of publishing the *Journal*. Printing costs alone have advanced 26% over last year. Numerous measures have been taken to compensate in so far as possible. A change in format beginning with the March issue was made in which 30% more type was printed per page at an increase in cost of only 11%. Beginning with the March issue all local copies were delivered without using the conventional envelope. Faced with an increase in the cost of production without any indication of an increase in income, the *Journal* has and will continue to effect savings wherever possible. Your dollar can only buy a dollar's worth of printing whatever the market may be. Increased cost of production without increased income can in the final analysis mean only fewer pages in each volume of your journal. The report of the Business Manager was accepted.

Respectfully submitted,

John A. Miller, *Secretary of the Board.*

REPORT OF THE LIBRARY COMMITTEE

Columbus, Ohio, April 14, 1942.

To the Council of the Ohio Academy of Science:

The greater part of last year's report was composed of the story of the pictures of the charter members. Thanks to the officers of the Academy and to the Editor of the *Journal* they were published in the July issue as a part of the History of the Academy written by Mr. W. H. Alexander. Reprints were purchased and a copy was sent to every person who had supplied a picture. Many favorable comments were received and a few extra copies were sold.

The sales of publications amounted to $20.55 including sales tax. While not a large sum it was a little more than twice that of the preceding year. An itemized account of the sales and

this amount less 49 cents expended for fifty sales tax stamps have been given to the Treasurer of the Academy. Twenty-seven copies of the Special Papers were sold of which thirteen were Dr. W. G. Stover's Agaricaceae of Ohio. Also the paper on Preglacial Drainage of Ohio became popular again. Dr. Stover's paper has led in the number of copies sold for several different years and also over the past twelve-year period with a distribution of 93 copies. The one next to it was Max Morse's Batrachians and Reptiles of Ohio with a total of 55 copies during that time.

A statement concerning the foreign exchanges may be of interest. It was reported to the Council last year that the Business Manager of the *Journal* had sent notices to each exchange outside the Western Hemisphere stating that the issues of the *Ohio Journal of Science* would be held here until normal times unless the recipient wished them sent at his own risk. In due time fourteen such replies were received. They were from places in England, Russia, India, China, Java, and Australia. However, starting with the next issue, No. 3, for May, 1942, the *Journal* will not be sent to these nor to any place even in the Americas outside the United States itself. Strict censorship regulations have made this necessary, and unless there is some change in them it will likely be our policy as long as the war lasts. Nearly seventy names will be removed from the active mailing list and the Business Manager will send each one a notice to this effect. The only foreign periodicals that are now being received on exchange are coming from England and her dependencies, Central and South America, and only this week from Portugal and Sweden.

Some interest has been shown lately by various libraries in completing their sets of the Annual Reports and Special Papers of the Ohio Academy of Science. Requests have come from Mexico City, Florida, and Missouri, and an order for a nearly complete set has just been received from Louisiana. There is a large stock on hands of all the Annual Reports and a fairly large supply of nearly all the Special Papers. Four of the latter have been withdrawn from general distribution to conserve the stock for the sale or exchange of complete or nearly complete sets. There are 16 copies of Dr. Lynds Jones' Birds of Ohio, 14 of Dr. F. L. Landacre's Protozoa of Sandusky Bay, 9 of Dr. Raymond C. Osburn's Fishes of Ohio, but only one copy of Professor J. H. Schaffner's Trees of Ohio, which had been his own personal copy. The remaining seventeen papers range from 51 copies to 614, with half of them having more than 95 copies. Of the Annual Reports only two have fewer than one hundred copies in stock and fifteen have more than two hundred.

The members of the library committee have had some recent correspondence concerning the distribution of this stock and they will welcome any suggestions for effective means of putting some of it into circulation. So far two plans have come to mind. One is to send the price list again to book dealers for it has been several years since this was done. However much of the material in the Special Papers has been replaced by later publications by other authors so that there is not likely to be a great demand from dealers for these earlier papers. So the second plan will probably produce more immediate results. The new Union List of Serials is now in press and will be issued during the coming Summer. As it will give the periodical holdings of all the large libraries of this country and Canada it will be a simple matter to note the numbers of the publications of the Ohio Academy of Science which are lacking from the sets in these libraries. Then offers can be made to supply them either on an exchange or a sale basis as the case may be. The results will be reported next year.

Only two new exchanges were added during the year but they are both quite desirable and were offered voluntarily. They are the American Geographical Society for its Geographical Review and the Reading Public Museum for its scientific publications.

Respectfully submitted,

Ethel Melsheimer Miller, *Chairman.*

REPORT OF COMMITTEE ON NECROLOGY

To the Ohio Academy of Science:

Your committee has learned of six deaths of members during the year, all teachers and all well past mid life. The report will consider the deceased members in alphabetical order.

George Ellett Coghill was born at Beaucoup, Illinois, March 17, 1872, and passed away July 23, 1941, in his 70th year at his home in Gainesville, Florida.

Mr. Coghill came up through the local schools and studied from 1891–94 at nearby Shurtleff College, Upper Alton; then transferred to Brown University where he graduated in the Classical course in 1896. He followed this with a year of graduate work in the conservative theological school and then shifted to the open spaces of New Mexico where he spent five months in thought and observation which gave a lifelong bent to his work and philosophy.

He afterwards registered at the University of New Mexico and completed the work for the degree of M. S. in 1899; returning to Brown he completed his Ph. D. work in 1902. Three honorary Sc. D. degrees have been given him, Pittsburgh in '31, Denison in '33, and Brown in '34.

Dr. Coghill's teaching record began in the year 1899–00 as assistant Professor of Biology at New Mexico. From 1902–06 he was Professor of Biology at Pacific University; Professor of Biology in the College of Arts and of Embryology and Histology in the College of Medicine of Willamette University, Salem, Oregon, 1906–07; Professor of Zoology at Denison University, 1907–13; Associate Professor of Anatomy, Kansas State University, 1913–16, and Professor, 1916–25. From 1917–25 he was head of his department and Secretary of the School of Medcine. For the next ten years he was Professor of Comparative Anatomy at Wistar Institute, Philadelphia, and a member of its board of advisers since 1926. In 1928 he was visiting lecturer in the University of London.

He became a member of the Ohio Academy of Science while at Denison and carried memberships in American Association of Anatomists, (Pres. '32–33); American Neurological Association; American Psycho-pathological Association; American Association of Zoologists; American Philosophical Society; National Academy Science, D. G. Elliot Medal, 1930; Society of Naturalists and other local and state academies and societies. He was editorially connected with the Jour. Comp. Neurol. from 1904 to 1941 and managing editor from 1926 to 1933, and a member of the Kansas State Research Committee in 1919. In all his editorial labors he was a trusted advisor, with rare judgment and impartial justice.

In his second summer out of college he resolved to "study the nervous system in a biologic system in a biologic approach to a scientific psychology and a naturalistic philosophy." Thus at the beginning of his career he formulated a specific program of research and followed it ever after, continuously, consistently, and intensively.

He early and fortunately chose the salamander, a primitive, generalized form, for his main studies and broke new ground in his methods of work. From youngest embryos to adult forms he worked with this group as his own enterprise in conception, observation, and interpretation. He attempted to correlate by anatomical and physiological studies the growth of the nervous system and the progressive differentiation of its organs, with the patterns of behavior adopted by the organism. His far-reaching results were an impressive demonstration of unity and integrity of the organism, and the dominance of total patterns over partial patterns at all stages of normal development.

"The accuracy of his recorded observations has been checked by numerous observers and his conclusions seem to be securely established for the material studied."

Dr. Coghill was a resolute supporter of the *Journal* with which he was so long connected, publishing about half of his papers in it. He was steadfastly an inspiring teacher, a persistent research worker, a loyal personal friend and a man with great faith, honesty, and devotion to duty.

His London lectures resulted the next year in a book of 113 pages and 52 figures issued by the Cambridge University press under the title "Anatomy and the Problem of Behavior." His presidential address in '33 before the Association of Anatomists was published in its Journal, Vol. 78, under the title, "The Neuro-embryologic Study of Behavior, Principle, Perspective and Aims." In 1936 he published "Integration and Motivation of Behavior as a Problem of Growth" in the Journal of Genetic Psych., Vol. 48, and in 1938 "Space-time as a Pattern of Psycho-organismal Mentation" in the Amer. Jour. Psych., Vol. 51.

From 1914 to 1936 he published a series of twelve papers in Jour. Comp. Neurology called "Correlated Anatomical and Physiological Studies of the Growth of the Nervous System of

Amphibia." Other papers were printed in Anat. Record and in Science; eight or nine papers were joint products with students and colleagues. His 62 titles covering the years '98 to '41 are listed in the Jour. of Comp. Neur. 1941, Vol. 75, pp. 195–98, the source of many data of this memorial.

Dr. Coghill was a philosopher as well as an anatomist, neurologist and psychologist, and his colleagues and pupils complained that he never wrote enough of the philosophical and psychological implications of his demonstrations, though he never lacked interest nor ceased to drop remarks that showed his comprehension of them.

In 1935 none too strong he retired to his farm at Gainesville, Florida, near the State University where his enthusiasm and wisdom were an inspiration to many.

Mrs. Hermine Zipperlin Hansen was born in Clinton, Ohio, March 30, 1858, and died in Akron, Jan. 8, 1942, at nearly 84 years of age, full of good deeds in civic clubs and groups, musical, religious, philanthropic and educational. In some she rose to the highest offices. She did much to popularize science, particularly geography, zoology and botany.

Her father, Dr. Zipperlin, was a pioneer physician in Ohio. She early moved to Cincinnati with her parents where she received all her formal education, graduating from the University with the honors of Phi Beta Kappa.

She taught a number of years in the elementary schools, then in Hughes High School of Cincinnati. Married Hans H. Hansen. After his death she returned to teaching in Cincinnati where she labored until her retirement when she came to Akron to live with her sister.

She traveled twice around the world, visited Europe several times, Alaska, and the South Sea Islands, and of these trips she wrote interesting accounts and often addressed groups telling of her observations.* Held in high esteem by many in her two cities she was always able and willing to help in community affairs and maintained a keen live interest in world affairs to the last.

Jesse R. Harrod was born at Harrod, Allen County, Ohio, in 1885, and died in Lima Memorial Hospital February 24, 1942, at the age of 57. He came late to his collegiate work but the more serious for the delay. His educational attainments are marked by a B. S. in Ed. 1918, and B. S. in 1919 from Ohio Northern University; and by M. S. in 1925 and Ph. D. in 1933 from Ohio State University.

Mr. Harrod was head of the Science department in the Ada High School 1919–21, Assistant Professor of Chemistry in his Alma Mater 1921–28 and became Professor of Chemistry in the same after a year in Science in Piqua High School. He became chairman of the department in 1930 and continued nearly twelve years.

Dr. Harrod was elected to Sigma Xi and sustained memberships in American Chemical Society and International Association of Torch Clubs, besides his affiliation with the Ohio Academy. In the latter he was one of the founders of the Chemistry section. He was joint author of Outline of Organic Chemistry.

Clarence Heskett was born in Bethesda, Ohio, fifteen miles west of Wheeling, W. Va., January 10, 1892, and died in his fiftieth year at Columbus, October 6, 1941, and was buried at his birthplace.

Mr. Heskett was one of twelve children on a farm in Belmont County. His grandfather was a pioneer farmer clearing primeval forests to plant his first corn and wheat. His father likewise was a farmer and a teacher and six of his brethren have been teachers.

Mr. Heskett attended the local schools and spent 1916–20 at Denison, graduating at the end although he had spent ten months of his junior year in France, and then flew with Dr. Kirtley Mather across South America over the Andes and down the Amazon and one of its tributaries. He thus spent six months mapping and studying.

He taught school and rose to a principalship in the schools of his home county during the next ten years. A continuous ambition for graduate work urged him forward and about seven years ago he came to Ohio State University and began the double rôle of assistant in the department of Geography and graduate student. He had nearly completed the requirements for the doctorate when his untimely death closed his career.

"James Allen Nelson, a member of the Academy since 1907 and a Fellow since 1940, was born at Urbana, Ohio, April 29, 1875, and died at Gambier, Ohio, August 9, 1941. He was

graduated from Kenyon College with the degree of Ph. B. in 1898 and received the Ph. D. degree from the University of Pennsylvania in 1903. His doctor's thesis was a cell lineage study of the early development of a species of brackish water worms, *Dinophilus*, to which he later gave the specific name *Conklini*, a member of a primitive group of animals which have been variously placed among rotifers, annelids and tubellaria. Later he also studied the adult structure of this species and from both pieces of work concluded that the genus has close affiliations with the chaetopod annelids. His graduate work did not include enough on insects and spiders to meet his desires and in 1904 he accepted an honorary fellowship at Cornell University where he remained for four years. He worked under Professor Comstock and made contributions on the palpi of spiders. Because of the high skill which he had shown in microscopic work in the field of embryology, and also because of the newer interests which he had acquired in insects, he was appointed to the U. S. Bureau of Entomology in 1908. Here he prepared his noted book on the embryology of the honeybee and later published papers on the larval structure and abdominal segmentation of this species. With Sturtevant and others he published observations on honeybee growth. As one who worked with him, acknowledgment should also be made of his keen interest in anything which would add to the facilities and effectiveness of the office with which he was associated. He resigned his position in 1918 because of ill health and was not again able to undertake a regular activity. His keen interest in gardening and his skill on the piano provided him with abounding interests for the remainder of his life. He finally settled in his old college town, Gambier, where he took much interest in the affairs of students, of members of the faculty and of his fellow citizens of the community. Nelson was a member of the American Society of Zoologists, the American Association of Economic Entomologists and of the Ohio Academy of Science. He is survived by his wife and one daughter."

—E. F. Philips.

(From the March, 1942, *Annals* of Entom. Soc. Amer., Vol. 35, No. 1, p. 125.)

Adam P. Seyfried passed away Aug. 29, 1941, at the age of 44.

He began his teaching in St. James High School in California in 1916. Later he transferred to Detroit, but after several years there in order to strengthen his preparation he became a graduate student at Fribourg, Switzerland. In these years, 1924–28, he gave himself assiduously to the science subjects which were to be his medium in years to come of imparting those high qualities of education that make for justice, honesty, persistence and scholarliness.

He was a biologist, a teacher, a man of geniality and vitality, a lecturer of note, a vigorous example for youth, "a Christian educator without enemy and without pettiness" in the school system of his faith.

Rev. Brother A. P. Seyfried, S. M., of Brooklyn, N. Y., though a student and teacher elsewhere for twenty-five years, was a member of the Ohio Academy of Science. He was also a member of the A. A. A. S., National Association of Biology Teachers and other scientific organizations.

He was a friendly teacher, an exemplar of honesty, simplicity and vigor of life, a man of high purpose.

George D. Hubbard, *Chairman.*

REPORT OF COMMITTEE ON RESOLUTIONS

The Committee on Resolutions recommends that we express our appreciation for the very cordial reception we have received from our hosts: Denison University and the people of Granville.

The efficient planning on the part of the local committee has resulted in a program which has been unexcelled in the precision of its organization and facilities.

The tea planned and presented by the faculty for the ladies of the Academy is duly appreciated and is but one of the many indications of the cordial reception enjoyed by the entire Academy.

In co-operation with the weather-man and in spite of Hitler and others we may now record a most successful meeting for which we offer a vote of thanks.

G. W. Blaydes,
J. Paul Visscher, *Chairman.*

AUTHORS' ABSTRACTS AND BRIEF ARTICLES

B. THE SECTION OF BOTANY

Vegetative Growth, Development, and Reproduction in Kentucky Bluegrass:—Morgan W. Evans, Wooster, Ohio.

A study was made of growth, development, and reproduction in Kentucky bluegrass (*Poa pratensis* L.), the most important grass in lawns and pastures in the northeastern United States. The effects of fertilization with nitrogen upon this grass were also studied.

The formation and growth of leaves on established shoots, the lifetime of the leaves and the lengths to which their blades grow, and also the lifetime of both reproductive and barren shoots are described. Vegetative reproduction, through lateral branch shoots and through rhizomes, and the time of the year in which each type of branch develops, are discussed. The initiation of the inflorescences, through the formation of protuberances on the growing points during the winter months and the development of these inflorescences in the spring, are described. A number of illustrations, including several graphs, one of which shows the annual cycle of growth, development, and reproduction, accompany the report.

*A Report on the Progress of a Three Year Study of the Plants, Microclimates and Soil Conditions at Neotoma Valley, Hocking County, Ohio**:*—John N. Wolfe, Richard T. Wareham, Herbert T. Scofield, The Ohio State University.

Since October, 1939, the writers have made weekly observations of the plants and have measured climatic and edaphic factors in many habitats at *Neotoma*, a typical, cliff-bordered valley in the so-called Sugar Grove region of Hocking County, Ohio. Over 400 man-days have been spent in the field in an attempt to measure and record in detail, extremes and variations of the following: precipitation (1 station); maximum air temperatures (34 stations); minimum air temperatures during fall, winter and spring (143 stations); evaporation from atmometers (42 stations); soil temperatures at depths of one foot (16 stations); minimum and maximum temperatures beneath leaf mold (10 stations); stream water temperatures (2 stations); continuous records of temperature and relative humidity (4 stations); soil moisture equivalents and fluctuations (15 stations); and light intensity (3 to 7 stations). Stations are located on the ridges, various slopes, cliff tops, cliff faces, cliff ledges and crevices, valley bottoms and habitats in the cove at the valley head.

Precipitation and temperature data are obtained daily at one station at the mouth of the valley. Brief studies (5–24 hours) of three habitats have been made simultaneously at various seasons of the year, with many of the above factors measured at half-hour intervals or less.

The flora of the area is being listed and plants are observed with reference to distribution, time of flowering, time of flower-initiation, rate and season of growth, abscission of organs, and condition of plants at various seasons of the year. The ecology of the mosses and lichens is being studied.

A standard Weather Bureau recording precipitation gage; standard minimum and maximum thermometers, Taylor minimum-maximum thermometers of the Six type, recording hygrothermographs, Livingston atmometer cups equipped with mercury traps, Weston illumination meters, Eder-Hecht photometers, and a Leeds and Northrup portable potentiometer comprise the equipment used.

The following are only a few of the data obtained in different habitats in the valley in 1941. Annual maximum air temperatures at some stations did not exceed 80° F. In other habitats the annual maximum reached 120° F. These annual maximums occur in some habitats in the spring, in others during the summer or fall or both. Depending on the habitat, annual minimum air temperatures ranged from —25° F. to +14° F. Soil temperatures at one foot were never below 36° F.; leaf mold minimum temperatures ranged from 26° F. to 31° F.

*Paper from the Department of Botany, The Ohio State University, No. 450.

The frost free season varied from 125 to 254 days. The total relative evaporation from atmometers from May 1 to October 1 ranged from 1 to 6; one weekly range was 1 to 80. Growth occurred in some plants during certain periods through the winter, and some grew under the snow. More than 100 species of vascular plants retained green leaves through the winter season. The moss flora of the valley includes 114 species.

The field work has been partly financed by grants from the A. A. A. S. through the Ohio Academy of Science. By courtesy of Mr. L. B. Corwin, Project Supervisor Muskingum Conservancy District, certain costly equipment has been made available, without which no such comprehensive study could be carried on. We are indebted to the owners of the land, Mr. E. S. Thomas and Mr. M. M. McInturf, for much help, and also to our own department for making available certain equipment. The writers wish to express their thanks for this assistance.

It is planned to continue the investigation through 1942, after which a detailed report will be published.

Some Water Relations of Two Species of Lichens:*—Lawrence E. Yarman and Herbert T. Scofield.

The exposed sandstone cliffs of the gorge region of Hocking County, Ohio, are interesting plant habitats. The somewhat sparse plant communities are composed largely of certain species of algae, bryophytes and lichens. At Neotoma, a tributary valley of Clear Creek, two lichen species are prominent on the southwest facing cliff walls and cliff tops. *Gyrophora dillenii* is restricted to the near-vertical walls and *Umbilicaria pustulata* occurs on both walls and cliff tops.

Because of the obvious importance of water in a bare rock habitat and because of the paucity of information concerning lichen water relations, the writers are investigating the water relations of these two species of lichens. The problems proposed are to find out when water is absorbed and where the water comes from, how long water is retained, and what environmental factors are associated with changes in water content.

To date, the data obtained concerning these problems merit the following brief summary: (1) diurnal fluctuations in water content of some magnitude occur throughout the summer; (2) absorption of water vapor at night may be considered an usual phenomenon; (3) precipitation water is rapidly absorbed and on a typical warm summer's day may be lost in a few hours; (4) daytime loss of water may be related to any factor that steepens the vapor pressure gradient between the plants and the air such as direct solar radiation which causes a rise in lichen temperature considerably in excess of air temperature.

Thiamin Production by Actinomyces viridochromogenus:—J. Arthur Herrick and Const. J. Alexopoulos, Department of Biology, Kent State University.

Actinomyces viridochromogenus was grown on an alkaline liquid medium. The cultures were then filtered, the filtrate acidified and autoclaved. This filtrate was found to support a heavier growth of *Stereum gausapatum* than similar media which had not previously supported *A. viridochromogenus*. Similar, but more pronounced results were obtained when *Phycomyces blakesleeanus* was substituted for the *Stereum*. When *P. blakesleeanus* was grown on agar plates previously inoculated with *A. viridochromogenus*, *Phycomyces* produced a much denser mycelium and a crop of sporangiophores in the vicinity of the *Actinomyces* colony. Since the growth of the *P. blakesleeanus* is a recognized assay for thiamin it is concluded that *A. viridochromogenus* produces thiamin in culture.

A Cytogenetic Analysis of Pollen Abortion in a Species, an Interspecific Hybrid, and a Polyploid of Solanum†:—Elton F. Paddock.

Solanum Douglasii Dunal and *S. nodiflorum* Jacq. are diploids (2n=24) of the *S. nigrum* complex, commonly known as Black Nightshades. They are native in California. All the

*Paper from the Department of Botany, Ohio State University, No. 451.
†Contribution from the Department of Botany, Ohio State University, No. 453.

pollen of hybrids between them is visibly aborted. The grains are empty and collapsed. Some strains of *S. Douglasii* are similarly completely male sterile, in others some of the grains do not abort, while in still other strains no grains abort. All plants studied were at least partially ovule fertile.

In completely male sterile *S. Douglasii*, abortion of the pollen grains occurs before degeneration of the tapetal layer.

Mean chiasma frequency per P. M. C. at IM is statistically significantly higher in male sterile and partially male sterile than in male fertile strains of *S. Douglasii*. Hence the abortion of pollen grains in these instances is *not* a result of chromosome pairing failures with such attendant anaphase distributional irregularities as would derive from a reduced chiasma frequency.

The mean chiasma frequencies per P. M. C. at IM in the original *S. Douglasii* x *S. nodiflorum* hybrid and its backcross progeny from pollination by *S. nodiflorum* are also statistically significantly different. Yet all the hybrid and backcross plants are completely male sterile. The decapitation-induced allotetraploid form of the original hybrid is also completely male sterile. Its chromosomes form multivalents. Thus, among completely male sterile plants, there are such fundamental cytological differences as to justify the conclusion that pairing irregularities have only a minor rôle, if any, in causing pollen abortion.

The genetics of pollen abortion is being investigated. Data at hand provisionally indicate the situation in the strains of *S. Douglasii* to be governed by two linked factors approximately 12.5 crossover units apart, the double recessive being completely male sterile. Pollen abortion in the hybrids, backcross progeny, and the allotetraploid seems best explained by complementary factors plus zygotic selection.

The investigation was supported in part through the grant of a Muellhaupt Scholarship.

C. THE SECTION OF GEOLOGY

Cause of Asymmetrical Drainage Pattern in Eastern Ohio:—G. F. Lamb, Mount Union College, Alliance, Ohio.

Many drainage patterns in this area having the principal stream of nearly east-west trend are notably asymmetrical in having longer tributaries on the north than on the south. This peculiarity applies to areas of widely varying size ranging from less than one square mile to more than 50 square miles.

It is found in regions of stratified rock that range from Silurian to Permian in age, and is most strikingly developed in areas where the rock is dominantly shale, as in the case of the Conemaugh and Dunkard Series. On the average north side tributaries are found to vary from less than 2 to 6 or more times the length of south side ones.

This asymmetrical character is known to occur in some degree in contiguous territory well beyond eastern Ohio and over an area of more than 30,000 square miles. It is therefore more than a local incident and due to some general cause.

Evidence is at hand that it is not due to the primary stream shifting laterally down dip; likewise that dip 5 times as great as the general dip has little or no effect on the length or course of streams; that anticlines and synclines are not the controlling factor. There is evidence that fault lines of small or of large throw exercise little or no control.

A study of streams at work under changing conditions seems to reveal that the *amount* of *sunlight* is a potent, and probably the dominant factor.

Flow Structures in the Berea Sandstone and Bedford Shale of Central Ohio:—John R. Cooper, Ohio Wesleyan University, Delaware, Ohio.

The structures in the Berea sandstone and the Bedford shale described in the past as "concretionary" or "disturbed" layers are shown to result from contemporaneous mass movements on the free surface of deposition. The top of the disturbed rock was generally truncated by erosion before the overlying undisturbed beds were laid down. Lateral movements

of the rock are evident in many instances and at many levels in the formations. These movements and others in which *lateral* movement is not readily apparent are interpreted as surface flows and slides, made possible by clay beds and seams which not only flowed readily but also acted as a lubricant between the sand layers permitting them to slide past one another. Comparable flows in modern subaqueous sediments have taken place on slopes as gentle as two or three degrees. Local slopes considerably greater than this existed on the Berea sea bottom as proved by cross bedding and channel fillings.

D. THE SECTION OF MEDICAL SCIENCES

Sequelae of Plumbism: Some Case Reports:—Emery R. Hayhurst, Columbus, Ohio.

Three compensation cases, all native born whites of various racial descents, suffered severe lead poisoning for 5 or more months after exposure in different well-known lead hazardous semi-skilled occupations, the last exposures occurring in 1937. In each case a number of fellow-workers were similarly concurrently afflicted. Numerous luetic tests were negative, except in one instance (Case III). Intelligence level, personal hygiene, customary diet and work habits appeared good in all cases.

Case I.—Female, age 17 when exposure (as decorator of glassware) began in 1935. Two attacks, 1935 and 1937. Continued ill-health followed, but she resumed work for 9 months to July, 1938, then miscellaneous jobs to early spring of 1940 when she married (age 24). Rather stout build, previously in robust health; a basketball player. Persistent symptoms: Obstinate constipation, other gastrointestinal, some neurological findings, moderate anemia. Much dental pathology since 1937. When about 4 months pregnant (September, 1940), X-ray showed absence of haustra in descending colon and sigmoid. While under prenatal care, foetus appeared as vertex presentation. At term, following prolonged pregnancy, a frank breech was found with premature rupture of membranes. Hospitalized, experienced surgeon assisted, delivery under complete anesthesia. Soft parts of birth canal proved non-yielding, necessitating episiotomy, and, finally, use of forceps. Unusually extensive laceration occurred, but apparently normal boy baby of nearly 8 pounds delivered. Despite immediate repair, a recto-vaginal fistula followed. This was present 3 months later, when former symptoms and findings still persisted, except anemia. Literature search yields nothing on such impairment of lower bowel and birth canal in relation to lead poisoning. Affliction of child of mother, becoming pregnant during acute plumbism, is well-known, but seems remote where several years have elapsed before conception. This child appeared normal at 3 months of age except for wry neck of tonic spasm character, probably consequent upon birth circumstance.

Case II.—Male, age 44 when first examined (1940). Auto finisher of soldered parts. Father of 4 normal children, wife well. Moderate lead dust exposure for over 20 years prior to 1937, when intensification of work was followed by acute attack with complete disablement for 5 months. Health never regained. Brief attempts at work unsuccessful. Tall, erect, well-built man, former baseball athlete, also World War veteran with about two years overseas. Health first suffered in 1932: Nervous breakdown, suspected heart impairment, cough and constipation, but no diagnosis made. Seen by many clinicians, especially since 1937, and four times by myself in past two years. Chief symptoms: Gastrointestinal (marked oral pathology, pains in epigastrium, obstinate constipation), subjective heart disturbances, spells of weakness, sweating, cold extremities, irritability and emotionalism, wasting of extremities without history of definite paralysis but numerous other neurological findings. X-rays showed marked coloptosis but no definite pathology in gastrointestinal tract. Gradual weight loss from 200 to 160 pounds since 1932, chiefly involving extremities, the trunk remaining robust. Cardio-vascular-renal system intact (January, 1942). An eczematoid skin condition, involving extremities for many years, now practically healed. Diagnosis: Low grade lead encephalopathy and cord changes—a not uncommon sequela of prolonged lead poisoning. Criteria for estimating atrophy or "wasting" is badly needed.

Case III.—Male, age 61 (1942), lead putty glazer on auto bodies for many years. Stocky, below medium height, composed mien, appears younger than age. Father of 10 normal children

(2 dead irrelevantly), steady worker, no past illnesses. First attack 1931, when disabled 4 months; second attack 1937, disabled 3½ years—both attacks following increased dust exposure. Now employed as sweeper when able to work. Inveterate tobacco chewer, also pipe and occasional cigars. No oral pathology (confirmed by X-rays), although molar teeth markedly worn down; 3 teeth extracted 1940 for "rheumatism" showed no definite pathology. Suffered gastrointestinal, cardiac, joint, moderate renal and nervous disturbances during attacks, with spell of acute glycosuria in 1938. Arthralgia now chief complaint, involving extensor surfaces of extremities and avoiding spine, shoulders and hips. Sticking pains also occur in bony chest cage. Hypertension (around 170/90–100) present since 1931. Some weakness of hand grips. Nervous system essentially negative. Aortic sclerosis but palpable arteries negative. Slight permanent swelling below ankles. X-rays made of left extremities show new bone formation and peculiar exostoses about extensor surfaces of elbow, wrist, hand and fingers, knee, ankle and foot. Joints not tender, but subject to aching following use, while lesions appear not so much *in* joint surfaces but in periarticular tendon connections, and along muscular and facial attachments to bones. We believe this condition not previously reported in connection with lead poisoning. Numerous luetic tests since 1931, of both complement fixation and precipitation types, negative, except for one Kolmer complement fixation in our examination which was four plus, but with Kahn and Kline tests negative. However, inconsistency in luetic tests has long been reported in lead poisoning. Diagnosis: Lead granular kidney and lead gout.

College Entomology

In this new text "the author has sought to furnish the essential facts about insects with which every well-informed person should be familiar" (p. v). It is written from a world point of view, and the species treated are those of particular interest because of their historical background, economic importance, or unusual and interesting appearance or habits. The text is divided into 36 chapters; the first three deal with metamorphosis (pp. 1–12), anatomy (pp. 13–52), and classification (pp. 53–58); each of the other chapters deals with one of the 33 insect orders.

The treatment in this text is largely systematic. In the arrangement of the various systematic categories the author has taken an advanced point of view; though every change involving the name of an order, family, or genus is evidently the result of much research,the author's arrangement may at first seem somewhat disconcerting to those students who are more familiar with the older and less elaborate systematics.

The chapter on metamorphosis is complete, concise, and well illustrated. That on anatomy is concerned largely with internal anatomy (15 pp. on external anatomy, 24 on internal anatomy); the discussion of external anatomy seems somewhat sketchy (e. g., two pages on mouthparts with two figures, and two pages on venation with no figures), but anatomical characters are more fully discussed in the chapters on individual orders. The chapter on classification contains a list of the orders and a key to the orders of adult insects.

Each chapter on an individual order contains a discussion of the historical features concerned with the use of names (usually in footnotes), the derivation of all names of family rank or above, common names of the insects in the order (often in French and German as well as English), a synopsis of the characteristics of the order (usually in tabular form), a discussion of the biology of the order, keys to the families, and a brief discussion of most of the families. At the end of each chapter is a list of selected references.

Any college course in entomology based on this text would be largely systematic; the book contains no organized discussion of the economic importance of insects or insect control, or of insect ecology, phases of entomology which would seem appropriate for inclusion in an entomology course.

From the standpoint of the material covered, this is an excellent book and should receive widespread use. It is well illustrated, and contains many worth-while features not ordinarily found in books of this sort. We particularly like the author's plan of outlining in tabular form the characteristics of the immature and adult stages of each order. The keys are workable and the characters are well illustrated. Though we noticed a few typographical errors, the book in general seems to have been carefully edited. It is well bound and printed on a good grade of paper.—*D. J. Borror.*

College Entomology, by E. O. Essig. vii+308 pp. New York, The Macmillan Company, 1942. $5.00.

THE CITY OF TOMORROW

The Presidential Address, 52nd Annual Meeting The Ohio Academy of Science

EUGENE VAN CLEEF

In 1932 I was privileged to organize the Geography Section of this Academy and tonight owing to your generosity and spirit of tolerance I am allowed to celebrate the tenth anniversary of that occasion. Again I may boast of a privilege, namely, the fact that you have for the first time risked the presidency in the hands of a geographer who is not associated with or shall I say not "contaminated" by a Department of Geology! Fully aware of the skepticism toward geography which ofttimes lurks in the minds of workers in the exact sciences I approached the task of preparing this address with certain fears and trepidation.

Sometime ago I was introduced as a geographer to a professor from a university in another state. "O yes," he said, "we have some of your kind in my institution. They are the fellows who include everything in their field." I must admit that the science of geography treats with the earth. The word geography still remains one of those words in the English language whose Greek root retains its original meaning. However, I know of no geographer who is either so bold or so nàive as to defend the concept that his science includes a study of all the physical and biological earth. Nevertheless, the fact remains that the list of aspects of geography of possible interest to an audience such as I face this evening is long, but the list which I myself might treat satisfactorily is limited. At first I was tempted to discuss the history and philosophy of my science, thus for "all time," to disabuse your minds of some of the impressions you may hold with respect to the present-day meaning of geography. However, to do justice to so vast a field in less than an hour seemed futile. Instead, I decided to treat with a phase of the field of urbanism, a field of particular interest to me, one which is relatively new in America and one which must command our serious attention not only after the war but even during its prosecution. And so for the next few minutes I ask you to bear with me while I consider some aspects of The City of Tomorrow as viewed by a geographer.

One of the amazing phenomena of American History is the fact that little energy has been expended either by individuals or governments in the study of cities. Only in the last few depression years under the stimulus of the National Resources Planning Board has official recognition been given by the United States Government to the city as a resource and as a part of the nation worthy in itself of intensive study. This board has appropriately stated "The prosperity and happiness of the teeming millions who dwell (in the cities) are closely bound up with that of America, *for if the city fails, America fails.*" The first important general treatise on cities was published by the national government. It was entitled "Our Cities" and was produced by the National Resources Planning Board only five years ago. Other publications of a more technical and intensive nature have followed. The first national conference on city planning held in this country occurred just six years ago.

Throughout its history the nation seems to have been far more concerned with rural problems than with urban. This has been especially manifest during the depression years, when politicians, paradoxically enough, have vied with each other to save the tiller of the soil from starvation at the expense of the non-food producing small merchant and manufacturer in the cities. This keen interest in

the farmer shown not only by the politician but by many other citizens has no doubt been actuated by selfish motives. We who live in urban communities, always dependent upon the farmer for our food supply, have neglected to study the cities not because we love them less but because we love our food more. Happily, a new era is dawning in which this selfish bias is about to be replaced by a better logic in the relations between rural and urban life structures, for unlike an earlier time in our history, today three-fifths of the nation's population inhabits our cities and only 17.6 per cent of the nation's workers is engaged in agricultural pursuits. Remarking upon the close association between rural and urban peoples, Mark Jefferson, one of America's able geographers, has well said, "What is rather carelessly called rural population is only the least nucleated part of a nucleated whole. Rural folk awake and at work are tied up to the city in every act of life."

Cities as human institutions are essentially as old as man himself. They have not always been large settlements measured in thousands of inhabitants. In fact, so far as concerns the geographer, the terms city, town or village have no more than political significance. As you know, some years ago the United States Census Bureau arbitrarily established a floor of 2500 as the minimum for urban centers. Some states use a higher figure. In Ohio, for example, no aggregate of people may qualify as a city until its numbers reach 5,000. But, functionally, what can distinguish between a community of 5,000 and one with 4,990? Obviously the distinction is purely one of convenience. Accordingly, some geographers are dispensing with size differentials and instead throwing all settlements into the single category "trade center." You may be interested in the fact that whereas on the basis of the Census Bureau's limiting number of 2500 for urban centers, the urban population of the United States exceeded the rural for the first time in 1920. If the Bureau had lowered the floor to incorporated places of 1000, then the 1910 census would have revealed an excess of urban population. And if unincorporated places had been included the excess would probably have been established in 1900. One geographer defines the trade center as an aggregation of people attached to a limited area of the earth's surface to derive such benefits as co-operative effort may yield. Hence when I use the expression trade center, you will understand that I may mean city, town, or village, incorporated or unincorporated and without regard to political limitations. Before viewing the City of Tomorrow, we need to examine the city of today.

CITY ORIGINS

Cities originate under varying circumstances. I cite a few of them. Cities have arisen for reasons of protection, individuals finding greater strength in numbers than in themselves alone. Cities have arisen around the central market place to which farmers have brought for exchange their various wares, either foodstuffs or handicraft or both. Cities have evolved from fortress centers, or at points along trade routes where bulk had to be broken. Religious shrines have given rise to city origins, as has the discovery of mineral hot springs with medicinal value, or climates for sports or health, or landscapes for the delectation of man's esthetic sense. Each of you will immediately recall certain centers that fit some one of these categories. But these are not all of the origins nor necessarily the most interesting. Some trade centers have been established by individual dictation or conscious group planning. Leningrad and Berlin were ordered by monarchs. Washington, D. C., and Canberra, Australia, were established by general governmental decree. So, too, were the recently created government "Greenbelt Towns" one of which is located just outside of Cincinnati, named Green Hills. The latter are unsatisfactory experiments in the realm of the City of Tomorrow. Some cities have been erected by owners of single industries, among which may be noted Gary, Indiana, or Port Sunlight, in England.

Cities by decree are of particular interest to us because they involved planning and planning required an investigation of city structures, both present and past. In turn, these studies revealed the complexity of urban units and still more important, their deficiencies. Findings of planners of new centers also aroused many persons living in established communities to the need for study of their respective habitats. At the turn of the century, sociologists, social workers, and geographers began to focus their energies upon studies of cities and, today, as I have already indicated, the national regime and some fifteen hundred of our urban centers have established special committees under various names, such as planning boards and planning commissions, to give consideration to planning for tomorrow. American geographers had lagged behind Europeans in their urban researches, but today they are not only abreast of them but probably are devoting even more attention to this subject and endeavoring to see into the future.

STRUCTURE

Before we may plan intelligently, we must have a full appreciation of the nature of the structure to be planned and of the function it is to perform. Let us look at structure first. Cities are three dimensional formations. They rest upon the plane of the earth's surface, and their buildings coincide with an intersecting vertical plane. In these two planes the works of man assume various forms. There is the design in the horizontal plane as reflected by the street patterns. These patterns may be classified as rectangular, radial, or a combination of both. The rectangular pattern is usually characteristic of flat or level surfaces, but examples are legion of this pattern in hilly cities where no regard has been shown toward steep gradients—where streets literally stand on end. Such a design is bad enough where climates are salubrious, but where we find it in cities where winters are noted for snow or freezing rains, one wonders that even the element of trial and error could have produced such effects. Clearly the radial or irregular pattern involving curved streets or those that deviate from right angles with each other is the logical for localities of considerable relief. On the other hand, we find in regions of flat topography, streets as fantastic as a mystic maze due either to accidental circumstance or conscious planning by some land developer—a design meant for the expression of beauty. Curved arteries sometimes make for beauty, but on flat terrain they certainly do not make for efficiency.

A rectangular pattern provides the possibility of numbered streets and a decimal system for the numbering of both business and residential buildings. A number may be assigned to a street, a letter to indicate direction of its axis in terms of the cardinal system and building numbers may be limited to 100 to the block, these numbers corresponding to the street numbers. No such arrangement is possible in a radial design. If we recall that streets are highways for communication, we shall appreciate that their arrangement in a manner to facilitate the locational function is of primary importance. Few persons can orient themselves on straight streets. Imagine their utter bewilderment in exploring irregular arteries.

The radial pattern yields numerous isolated triangles, circles or irregular islands which rarely are usable economically for building purposes. They are good for parks, monuments and other kinds of ornamentation. But there is a question as to the virtue of these latter uses in proportion to the cost involved. One constructive quality which the curved avenue contributes to urban life, is the maintenance of the pedestrian's interest. As he looks ahead the distant landscape is always framed and his interest, not to say curiosity, in what is just beyond him is continually revived by the unseen around the bend.

I do not argue for the utter elimination of the radial design. The pattern should be adapted to the topography. However, I voice objection to it when the terrain does not compel it as the most practical device.

FUNCTIONAL ELEMENTS

Upon the areas facing these streets and avenues, must be erected the functional elements of the trade center. In practice the functional pattern and physical surface may not be divorced. All too rarely have heights of buildings been related to widths of streets and widths of streets to projected heights of buildings. We have ignored the angle of the sun's rays at different seasons of the year and the consequent varying lengths of shadows cast by structures of different heights. We have failed to relate traffic flow of workers in and out of buildings and density of general traffic flow to width of highways.

Functional patterns of trade centers tend to fall into stereotyped forms. In the downtown district is a miscellany of public buildings, retail stores, autobus and railroad stations. Next to them are wholesale houses and some manufactural industries, then a poor residential zone, a better residential area and on beyond the region of the homes of the well-to-do. Major arteries of bus or street car services radiate from the center of the city. Strung along these avenues are emergency supply shops or neighborhood marketing centers. Parks, playgrounds, schools and churches are scattered about, not always with reference to actual needs.

Some of this conglomeration is in process of transformation. Industries are moving out of the heart of the city; schools and playgrounds are being located with reference to actual population, accessibility and needs; street car tracks are being removed; railroads are being electrified and their tracks in some instances placed below ground where they enter the city or enter railroad stations. Even the skyscraper, with its contribution to congestion and all that this implies, is relegated to the past. These and many other changes are being effected. In fact, because some years ago these rearrangements were in process of being made independently of each other and in some instances upon a trial and error basis, zoning laws were formulated in an effort on the part of those with an appreciation of the value of planning, to prohibit the recurrence of an unco-ordinated building of the city. Concerning planning, I shall have more to say momentarily. First, I wish to consider the other half of the story of city structure, namely, the environment to which the internal urban structure is closely related.

UMLAND

I have alluded to the political limits of a trade center, within which lies that area technically called city or village. Immediately adjacent are located suburbs, farm and vacant lands, in which the inhabitants look to the city for their economic and cultural well being quite as much as do the people within the city. This region I call the umland, resurrecting a term used by the Germans some years ago and subsequently dropped from common parlance. The suburbanites are largely parasitical. I do not mean to offend surbuban dwellers. But it is a fact that they receive many of the benefits of the city for which they pay nothing. Public utilities of the city are generally drawn upon by the umland and their construction within the city is frequently affected by their extension beyond the city limits. And then there is that sharp line of demarcation, the political boundary between the city and the umland where city laws cease to have effect often to the advantage of the umland resident. Because of this close association of the people of the umland and the city, Mark Jefferson has said the United States Census of population is misleading. He states it is the census of our population "asleep" and does not give an accurate account of the location of our population "at work."

THE CONTINUOUS HINTERLAND

The umland is not only a part of the trade center, but in a sense is also a part of a larger area which I call the continuous hinterland. However, for my purposes, the inner limit of the continuous hinterland is the outer limit of the umland. I conceive this hinterland to include that area in which the residents look to the

major trade center for most of their trade relations and much of their cultural inspiration. Like most natural boundaries, its outer edge is zonal. The influence (upon the city) of the occupants of the continuous hinterland may be less than or greater than that of the residents in the umland. The existence of most trade centers is probably due to the sum total effects of the natural elements in the region of the continuous hinterland. And here one may pose a question quite as difficult as the proverbial one which seeks to know whether it is the chicken or the egg which appears first. Does the city or the continuous hinterland appear first? I shall not stop to expound upon this question but shall merely assert that in most instances the relationship between city and hinterland is reciprocal once the city is established. On the other hand, with few exceptions, no city would exist were it not for the elements which constitute the continuous hinterland.

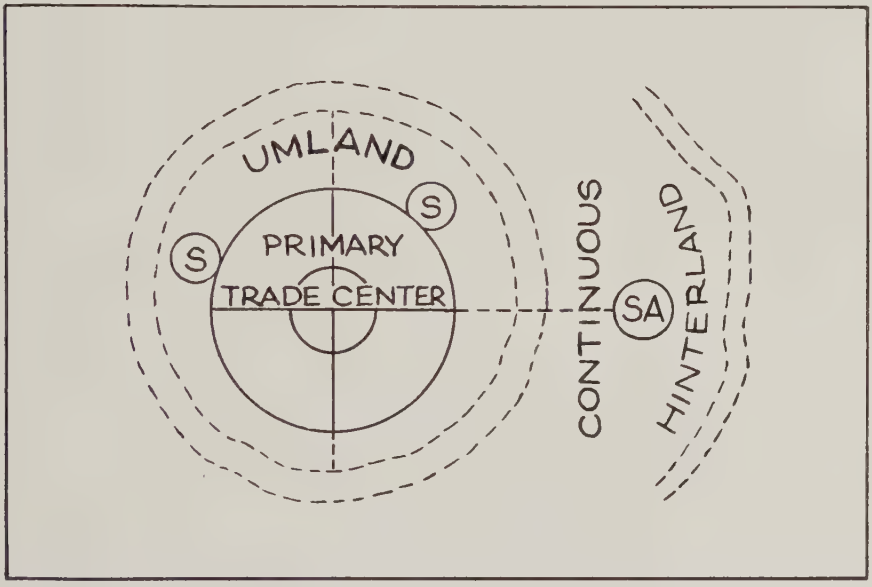

FIG. 1. The Primary Trade Center plus the Umland constitute the geographical or metropolitan city. The Umland includes the suburbs (S) and other areas immediately adjacent to the primary trade center which behave economically and socially as though they were politically a part of the trade center.

Although the Umland may be interpreted as a part of the Continuous Hinterland, its relations are so much more intimate with the primary trade center, that its distinction from the Continuous Hinterland seems desirable. The latter incorporates that territory beyond the Umland, to and including satellite (SA) centers with their Umlands, in which there is much dependence upon the primary trade center, but less than that indicated for the Umland area.

Boundaries of both Umland and Hinterland are shown to be zonal.

PLANNING

In the light of the habitat status of people in our cities it seems obvious that the future of our trade centers can best be developed through the medium of planning. By planning, I do not mean regimentation. I do imply regulation of some ways of life and the removal of certain of those personal liberties about which Americans have so glibly spoken since the founding of this nation, but which we have never fully enjoyed. As we have said, cities are areas of the earth occupied by people, not people as individuals, rather people as societies, people seeking certain benefits through co-operative action. We as part of a society contribute to the defrayment of the cost of fire and police protection, of water supply, of street improvements, of recreational facilities and of public education. We submit to

laws that say we may not drive down the left hand side of the street; to signs which warn us to keep off the grass; to symbols which prohibit us from parking our automobiles in certain places and to many other restrictions. Sometimes we feel as though our personal liberties were being infringed upon, but on second thought we accept the law because we recognize that no organization can long survive if the individual members do not make some personal sacrifices for the benefit of the whole.

In the light of this willingness to co-operate, it seems strange that the progress of city planning has been so slow; that objections are so numerous. Often, individuals object to the erection of a filling station next door to the residence into which they may have poured much of their life's savings or are still doing so. Yet, they become irked when they are prohibited by zoning laws to sell a piece of property for similarly objectionable purposes located next door to some person unknown to them; or they object to the widening of a street in front of their property or to some other improvement in the interest of the public welfare. Sometimes these objectors eventually become enthusiastic supporters for projects forced upon them, after the projects are completed.

Planning as viewed by the geographer is not merely a matter of street improvements, bridge building, zoning, park construction, architectural control or any other one element among the many which compose the cultural landscape. The geographer views the composite as an expression of the earth's landscape. Just as the physicist and chemist look upon atoms as parts of the structure of matter, so the geographer conceives of the works of man as integral parts of the life elements of the earth's surface. The cultural landscape is just as truly a part of the earth's configuration as the forest or the mountain.

Man possesses that intangible and more or less mystical quality called consciousness, which can be overrated. An old Greek proverb says "The strength of a city is in the virtue of its citizens" and citizens of a city such as Chicago whose motto is "I will," seem to believe it is man alone that makes a city. However, while virtue and will may give man a certain power of direction for his acts, they do not release him from dependence upon the realm of nature of which he is a part. Level land, hilly land, poorly drained surfaces, surfaces interrupted by wide rivers, small streams, or waters flowing through deep canyons may well yield different reactions in terms of building construction and distribution. Rock outcrops, thin soils, bedrock deep below the surface, clays, sands, and deposits of metallic minerals give rise to further varying responses. The local climate, natural vegetation and native animal life are not without their effect upon the possible behavior of potential settlers. These local conditions, which we might have supposed to be self-evident, we are just beginning to appreciate—albeit a little late. Yet perhaps we should not condemn man too hastily for having resorted to the trial and error method in land occupance. Man as the species *Homo sapiens* has been on the earth according to some students of evolution only 60,000 years, and although he has led a communal existence for a large part of this period, the evolutionary process demands patience. However, we should take heart because we have in a sense arrived at a stage involving an appreciation of the fact that varying geographic conditions call for varying treatment. There is abundant evidence that we shall not have to await the passing of another 600 centuries before we transform this realization into action.

As a part of the earth's landscape, the trade center has form and structure. These qualities vary as individuals or even groups may vary in their inherited biological traits, but are conditioned by the inanimate and lower animate phenomena of the region in which the trade center comes into being. As you well know, the physical structures which man erects, occur in great assortment, ranging from sharply pointed cylindrical grass or reed huts of a primitive folk to complex skyscrapers in our modern cities. The geographer seeks to understand these forms and structures insofar as their existence may be the consequence of the elements of the earth among which they are located.

THE CITY OF TOMORROW

Thanks to planning and a scientific analysis of our cities with respect to structure, form, and function, the city of tomorrow no doubt will be much different from that of today. Our present experiments in city building, our conscious appreciation of the city as an integrated area for occupance by man will yield a different form if not a different function. However, that new form must be largely the response to function. Naturally, prediction in detail is hazardous, for man has inventive genius which gives rise to situations we cannot anticipate. Who would have built a city 50 years ago with streets wide enough to accommodate the automobile? Who would have even dared support the construction of airports as parts of the then modern cities? Who would have dreamed that urban profiles even in small cities would include the outlines of skyscrapers and that the skyscraper would so soon after its conception be rated as undesirable? So, I say, to forecast what the city of tomorrow shall be is to assume considerable ego. Yet we may make some statements as to the direction in which cities shall move and though these must be speculative they may become realities.

The large city of tomorrow may be smaller both in area and population than it is today while small cities may be somewhat larger. Aerial transportation will move people nearer in point of time to all of those advantages, imaginary or real, which large cities afford and thus eliminate the desire of persons in small communities to resettle in larger centers. Conversely, persons with aversion to residence in large centers who are there only by virtue of necessity will remove themselves to smaller centers and commute by plane. Thus, we may look for a redistribution of population as among cities.

You may ask "How many persons should constitute a satisfactory number for the American city? That is a difficult question to answer but I have ventured to forecast and hence hardly dare shirk the responsibility of an answer. In making this forecast I am reminded of Lincoln's response to the question, "How long should a man's legs be?" "Just long enough to reach from his body to the ground," was his *scientific* answer. An engineer, Klaber by name, has devoted considerable attention to this subject which has been helpful in enabling us to reach some conclusions. He has shown how the law of diminishing returns operates as a city grows in numbers. He divides a city into neighborhoods and demonstrates that the potential interrelations among these neighborhoods increases by a geometric ratio as the number of neighborhoods increases. He thereby arrives at a classification of cities involving three divisions, namely, "Micropolis" with four neighborhoods, "Megalopolis" with sixteen and "Metropolis" with sixty-four. Klaber shows that the co-ordination of civic interests becomes decreasingly practicable as the city grows and that business and industry should be made "a function of the employment and consumption needs of the people and not the cause for which people live." The planners of Letchworth, England, some years ago provided for a city of 35,000. That seemed large enough. Some new Soviet cities, in the post-World War I years, planned for 75,000 persons.

While no absolute limit can as yet be set for the ideal size of city, consideration of what may be required to establish adequate cultural and economic facilities for a satisfactory pursuit of happiness, leads us to the conclusion that few cities need to attain a population size of over 300,000 to 500,000 persons. This number certainly is subject to challenge. However, elaboration of the conclusion is not possible this evening.

AREAS

In the future, areas of cities may be reduced, or if not reduced, it is unlikely they will be enlarged. We shall make apartment house living more attractive as is being done today in many cities. Clearly, story piled on story provides for more living space upon a given area than does a single family dwelling. Among attrac-

tions of the new apartments will be community or co-operative kitchens not only reducing enormous waste of time and energy now involved in repetitive kitchens, but increasing living space. There will also be abundant park and play surfaces immediately associated with apartment buildings. Areas of trade centers will be reduced because of the complete elimination of smoke through the adoption of electrical heating supplied by current from concentrated sources. This reform will make livable the central portions of cities and thus return to more general use areas in such districts now abandoned. Sunlight will be adequate and gardens may be grown. There will be advantages derived from one's living within walking distance of his place of employment. There is no intrinsic reason for the maintenance of blighted areas in the inner city.

Whether the city pattern will consist of uniformly broad streets or some narrow and some broad as of today will depend upon the extent of the reforms just mentioned; also upon the continuance of the large automobile or its replacement by smaller ones; and upon the eventual character of the airplane for individual and public use. In any case the pattern will conform more nearly to the topography and to the elements of accessibility than it does today.

Characteristics of buildings facing avenues of transportation will likewise be affected by these probable changes in transportation forms. Landing fields atop buildings or small fields on the ground to be reached by vertical descent of planes will certainly affect both the architecture of most structures and the general urban pattern. The form of future buildings and the width of streets may be further influenced by air conditioning and by artificial lighting which will possess the therapeutic value of natural sunshine. If transportation facilities do not require broad streets, we may be content with narrow ones, since we shall be dependent neither upon direct air supply from the out-of-doors through windows, nor upon the angle of the sun's rays in relation to building spacing. If these new devices come to pass, then areas of cities may be still further reduced.

Our chemists tell us that Uranium 235 may provide all the energy needed for heat and power. Does this mean the elimination of the great power plants of today as well as all small installations? Will the use of Uranium mean that we shall have no more use for chimneys, for coal storage bins, for trap doors in sidewalks, or for filling stations? Herein may lay a further possibility for the reduction of areas or increases in park space without corresponding increases in urban areas. Herein lies another potential difference in the physiognomy of the city of tomorrow and that of today.

All of these fundamental changes will permit a freer play of our esthetic sense. We shall not tolerate the ugly urban landscapes composed of the present structures either for residential or business purposes. We shall have more citadels of Commerce, inspiration in the neighborhood store and more abundant color on the facades of all buildings whether for business or residential purposes, color applied with an appreciation for harmony.

In the city of tomorrow utility lines, if they are needed at all, will perforce be located underground. Street cars and trolley buses will have vanished entirely, except from the museums of transportation; street car tracks of course will be unknown to future generations. Perhaps all public conveyances will operate underground or in the air.

We are in imminent danger of destroying our cities by virtue of unplanned building suddenly thrust upon us by the war emergency. We are paying a terrific price today because yesterday we did not plan for the city of tomorrow. Our posterity shall pay also because we today are not planning adequately for tomorrow. Today we should plan, plan scientifically, for the City of Tomorrow, on the assumption that the city plus its continuous hinterland is the climax expression of a nation's level of civilization.

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SCIENCE AND THE WAR

A. R. OLPIN

The rôle of science in the present war appears, to the public, to be both that of the villain and that of the hero. It is accused of having brought about the conflict by its applications, and, at the same time, is expected to save the world from utter chaos. This paradox results from confusing the magic and gadgetry of applied science with the ideals and methods of science itself.

Actually, the applications of science are merely tools which men use to achieve their purposes. They are extremely powerful tools, capable of bringing about either destruction and death, or construction and life, depending upon whether or not the motives of those applying them are sinister or pure. Since war accentuates the good and evil in people and intensifies the effects of their acts, a study of the records written during wartime afford us an excellent opportunity to determine whether or not the applications of science are beneficial or harmful to the human race.

Let us examine these records for the last few wars, as supplied by the Surgeon General's Office. We learn that deaths due to battle injuries increased from fifteen per thousand for the Mexican War through thirty-three for the Civil War to fifty-three for World War I. However, the death rate due to disease for these same war periods decreased from one-hundred-ten through sixty-five to nineteen. The net death rate dropped, therefore, from one hundred twenty-five in the Mexican War to ninety-eight in the Civil War to seventy-two in the first World War.

It is perhaps too early even to estimate the likely death rates for the present struggle, but it is assuring to feel that though the implements of war resulting from the applications, or shall we say misapplications, of science have increased in destructiveness, scientific methods of combating diseases and preventing infections have been so effectively developed that those fighting now to preserve our democratic way of living may not be subjected to greater risks than those who have fought in former wars for us.

Modern warfare is unlike anything that has gone before. Someone has said it is organization for disorganization, and explained this by calling attention to the fact that offensive action always starts as a well-planned and directed spearhead at some point in the enemy line, but breaks up into individual mechanized units and fans out in all directions behind this line once it has been pierced. The column moves so rapidly that many of the troop-bearing vehicles become completely detached from the starting formation and small groups of soldiers must fight by themselves without co-ordinating orders. This is why professional soldiers have been so valuable in a blitzkrieg. Another reason is that they usually take the offensive and a defending army today is always at a disadvantage. Its troops must be spread over a wide area to anticipate a thrust at any undisclosed point. The only effective defense against a concentrated thrust of this kind seems to be a counter-offensive of the same kind. Even this can only succeed when there exists an abundance of supplies and munitions, and adequate air protection. Nothing seems to be more vulnerable to a dive bombing attack, for instance, than a column of soldiers attempting orderly retreat.

The techniques of modern warfare were highly developed by our enemy over a period of many years by careful planning and the full employment of scientific

research. Failure of the democratic countries to keep pace with them in this respect is a reflection of their general dislike for war. The previous world struggle had demonstrated the futility of bloodshed on the battlefield as a means of settling disputes.

In our own country, disarmament has always been more popular than armament. We have demonstrated our nàive faith that nations had learned the futility of war, by sinking battleships and reducing our army to a mere Federal police force. The idea of developing an "all-out" war industry based on scientific research was so far from our minds that it was hard to get the effort underway for a year or more following the outbreak of hostilities in Europe. Now we are facing a crisis and American science is being frantically mobilized on a wartime basis.

The problems of mechanized warfare are mainly technical ones. The manufacture of the weapons of war itself calls for the services of scientists and engineers. Tanks, aeroplanes, machine guns, submarines, battleships, torpedoes, bombs, all are constructed of machine parts which must be produced in large quantities yet with a precision that will permit interchange of these parts at will. The manufacture of the munitions of war calls for the operation of complex chemical plants by skilled chemical engineers without interruption. The miracle performed by American industry in converting existing factories into arsenals, and in creating new industries to meet the challenge of the emergency will be left for a subsequent speaker in this series. I merely want to comment in passing that these operations have required and still require the services of a vast army of scientists and engineers.

But it is no longer possible to win wars by sheer strength of numbers, any more than it is possible to do so by hiding behind a Maginot line. Modern wars are won by striking surprise blows, either where the enemy is not adequately prepared or with weapons for which he has not developed an adequate defense. This calls for ingenuity and originality and careful planning. It can only be accomplished by continual research and change.

In a country such as ours, wherein armies and navies are maintained during peace time at an almost irreducible minimum of strength, the problems confronting us in preparing for an "all-out" war are tremendous. We are fortunate, however, in that civilian participation in war is taken for granted in the United States, and that scientific organizations, born of war, have been maintained to assist the agencies of the Government on technical problems which they may submit. These organizations are the National Academy of Sciences, incorporated in 1863 during the Civil War by an act of Congress, and its subsidiary, The National Research Council, created by Executive Order of President Wilson in 1916, less than one year after the entry of the United States into the first World War. Neither of these institutions possess free money for research, nor do they have laboratories of their own; but they do maintain some 225 standing advisory committees composed of many of the country's leading scientists. At the best, however, these committees are fact finding groups, and have no authority to initiate projects.

At the time of our entry into World War I there was created the National Advisory Committee on Aeronautics. This agency was given more specific responsibility than the National Academy of Sciences or the National Research Council, and was charged with the supervision and direction of scientific studies of flight problems, with a view to their practical solution, and was directed to conduct research and development in aeronautics. There are 15 members of this committee including two representatives each of the War and Navy departments.

The success of this Committee prompted President Roosevelt, a year and a half ago, to create by Executive Order and establish as a division of the Office of Emergency Management, the National Defense Research Committee, with power to initiate and supervise scientific research on the instrumentalities of war. Congress appropriated about ten million dollars for this purpose. A year later a

Medical Research Committee was similarly organized to investigate problems of health related to modern warfare. Both the National Defense Research Committee and the Medical Research Committee were then subordinated to another newly created committee known as the Office of Scientific Research and Development. This committee was given $20,000,000 to spend on researches approved by its two subsidiaries. Already over 600 war research projects have been established in university and private laboratories by this committee under Government contracts. Numerous sub-committees and sections to deal with research on specific subjects have been created in the Office of Scientific Research and Development, and at present over 500 scientists are serving as members and consultants at no cost to the country. So effective has been the functioning of this office that one is disposed to hope that it also may survive the war period as a permanent institution.

In addition to the Academy, Council, and Committees just cited, whose members are diligently seeking to develop new instrumentalities of war and new methods of defense against enemy attacks and disease, there are numerous other specially created groups working on war problems. Particularly the National Inventors Council should be mentioned. It passes on the merit of inventions submitted by enthusiastic inventors anxious to help win the war, and brings to the attention of the armed forces those which look promising. Then there are the War Products Committees, busily working on plans to provide the necessary raw materials for "all-out" war, and Health Committees striving to maintain the health and morale of the armed forces and the citizens at home, and many others in various Government bureaus.

The scientists of the country have rallied whole-heartedly to the support of their country in these perilous times. So important is their work that they must, for the most part, be individually cleared by the Federal Bureau of Investigation before assignment to their tasks. And, unfortunately, the tasks are more numerous than the men. More scientists must be trained immediately. The National Selective Service has taken this into account and promising young men are being spared from active Army duty to complete their training. They are a loyal and patriotic group. Although not many are carrying guns, American scientists are on the march.

SCIENCE AND INDUSTRY

THOMAS MIDGLEY, JR.

Q. Our discussion today, Dr. Midgley, is about the role of science in industry. What have been among the outstanding contributions of science to industry, and where do the contributions of science to industry start?

A. Since mankind first developed co-operation, there have been activities such as the making of arrowheads that have been called industry. However, it was not until nearly two hundred years ago that what we now call industry started in England. This was founded on the application of power to production. I mean power other than man or animal power. This was done by James Watt developing the steam engine. This was not the result of young Watt watching the lid of his mother's teakettle blow off but actually was the result of applying science. Watt was an instrument maker at the University of Glasgow and was assigned a job of studying the operation of a steam engine used for pumping water out of mines. Watt decided that this device was inefficient and cumbersome and needed improvement. He spent two years in researching on the properties of steam and with the aid of this scientific knowledge was able to produce an engine that would not compare unfavorably with some of the present day. This made it possible to gather

people together in factories where steam power could be used and thus produce quantities of finished goods, the like of which had never before been seen. Thus what we call industry was actually founded upon a scientific development.

Q. Most of us, Doctor, think of science in industry as being solely in the laboratory and not something that is brought into the factory itself. Is this true?

A. No. For example, many years ago Mr. C. F. Kettering, who invented and developed the self starter, was calling on Mr. Nash in the expectation of obtaining a contract for that year's business. It so happened, that a competitive starter was being offered to Mr. Nash at $1.00 less than Mr. Kettering's. The arguments waxed thick and strong. Mr. Kettering continually telling Mr. Nash how much research Delco did in its laboratories to improve its products and Mr. Nash repeatedly saying, "I'm not paying that dollar just to run your laboratory." Finally with things deadlocked, Mr. Nash started talking about some troubles they were having with their rear axles and asked Mr. Kettering if he could make any suggestions. They walked through the shop to the heat-treating room and Mr. Kettering saw that they were judging the temperatures of the axle pieces being heat treated by eye so that on bright days they were bound to get the axles hotter, before quenching, than on cold days and that herein lay most of the trouble. So he said to Mr. Nash, "If you will just use pyrometers to tell what the temperature really is instead of guessing, your troubles will be over." Mr. Nash saw that this was so and thanked Ket for the suggestion. Ket said, "All right Charley, I learned that in our laboratory and now I want that dollar." And Mr. Nash signed the contract.

Q. Doctor, how does what you have been telling us apply to an every day article such as a refrigerator? How does science in industry apply to the refrigerator itself?

A. Well, in the first place, no savage has the slightest conception that he possesses the ability to make things cold by applying power but with the development of the science of thermodynamics.

Q. Well, Doctor, that sounds like a $64 word.

A. Yes, all of that, as I was saying with the development of this science, it became quite clear to one versed in this science that a machine like the engine of James Watt made to run backwards in principle could absorb power and pump heat out of things which is all one needs to do to make things cold. This is refrigeration. The household refrigerator is the embodiment of this scientific idea.

Q. Is then air conditioning nothing more or less than a glorified refrigerator?

A. In a sense, yes, but had that been all there was to it, the cooled dining car that ran from Columbus to Cincinnati in the 1860's would have been a success. Unfortunately, its designer knew nothing about humidity nor how unpleasant a person could be in air so humid that his perspiration would not dry. It was over half a century later before science understood these simple facts so that refrigeration could be expanded to give comfort in hot weather which is a simple definition of air conditioning. But even this was not quite enough. Reversing the principle of Watt's steam engine is not enough. Steam doesn't work well backwards. One has to use a substance with properties quite different than water to get results in refrigeration. In the early days of artificial ice making, ammonia gas was used exclusively as the refrigerant. Later with the advent of household units, SO_2 became very popular, also methylchloride. One trouble of applying such things to air conditioning was that if there was a leak, even a small one, people's lives were in danger. A new refrigerant was needed—one that was neither toxic nor combustible. Mr. Kettering saw that such a substance was essential to the development of air conditioning. So, one morning, he called me up and told me to get to work on this problem. With the aid of Dr. A. L. Henne the problem was solved by using dichlorodifluoromethane.

Q. I think that one should be worth $65.

A. Well, Paul, as a matter of fact, it turned out to be worth many millions and gave comfort to many millions more. So that today by the application of science to the improvement of refrigerants, a brand new industry came into existence, and air conditioning in theaters, restaurants, railroad cars, stores, office buildings, is well nigh universal. However, it has been terribly disappointing to see the American public fail to make more use of it in their homes. It is my feeling that had we been willing to raise our standard of living to the air conditioned level during the early 30's much of the depression unemployment could have been avoided.

Q. All right Dr. Midgley, you have explained the application of science to the common refrigerator. Now let me ask you how some lesser known science, such as say Entomology or bug study, can be applied to industry?

A. I see you too started on the $64 words.

Q. Doctor, I think it's catching.

A. As a matter of fact, Entomology has not played a very important part in what we call industry. Maybe we use some exterminators in the woolen goods industry and maybe we don't. I don't know. Yet if we look at the whole, Entomology is important. Many insect pests must be eradicated or at least controlled for successful farming. This is done largely by the use of chemicals called insecticides which constitute a fair portion of our normal peacetime production of chemical goods.

Q. Well, that answers my question, Doctor, and now getting back to the factory, what has science done towards the fabrication of metals, the making of steels and alloys? How does science work here?

A. Suppose we start at the beginning. Primitive man was unacquainted with the properties of metals. It is supposed that some ancient person used some sort of copper ore to blanket a fire. Later he discovered some particles of copper in the ashes and observed that here was a stone which could be fashioned by hammering and hence he could make arrowheads, knives and the like which were better than the chipstone implements he had been used to and so it went. Individual discoveries passed on from generation to generation building up a craft of metal work. For example, take the much vaunted steel of Damascus. Was this the result of science? No. Damascus steel actually was one of the poorest steels known to the ancient world. It was too hard and brittle for practical use so the blacksmiths of Damascus took small rods of steel and small rods of wrought iron, wound these together and hammered them into a single rod. These rods in turn were twined with others and the whole welded together by hard work. The result was a sword or a knife that could be sharpened to a razor edge and was held together by the tough wrought iron. No one else could make as good a sword. Today we would take the brittle steel of Damascus, analyze it, probably find too much phosphorous, add what would be needed to remove the phosphorous, in the furnace operation add some nickel, tungsten and vanadium and without any blacksmithing turn out knives, swords or razor blades that would make any Damascan green with envy. This is science.

Q. Using scientific methods, what have been some of the modern day developments in the fabrication of metals?

A. Well, you might call the railroad one, the Golden Gate Bridge another, the three hundred mile an hour airplane one more, telephone communication still another and so on ad infinitum.

Q. Along with steel, Dr. Midgley, rubber has contributed much to modern living standards. Where does science enter into the making of rubber?

A. It is said that Christopher Columbus took back a piece of rubber on his first voyage and this was the first contact that white men had with this very valuable material. Be that as it may, rubber was not of much value until Charles Goodyear

by applying research methods, discovered that rubber would combine with sulphur to give the remarkable resulting product with which we are all familiar. This was about a century ago. Since then other scientists, principally chemists, have added to the knowledge of and the utility of this material. The importance of vulcanized rubber to modern life cannot be over-emphasized. Without it we would have no automobiles, no electrical industry, no air brakes, no golf balls or airplanes, suspenders or erasers, faucet valves or garden hose. All of which depend upon this product of science. Again to emphasize its value, the Kaiser did not start the war in 1914 until his advisors told him that Germany could make synthetic rubber. They were wrong and Germany lost. Hitler made more certain. Today Germany supplies its own needs of synthetic rubber; product of science. We, on the other hand, have been a bit backward. Our hope is now that our scientists will catch up.

Q. What would you say, Dr. Midgley, in summing up the role of science in industry?

A. Industry is science. The two are inseparable, Siamese twins, except that some science would go on without industry but no industry could live long without science. Management which neglects science is neglecting its business and failure will be the ultimate reward. New applications of science mean success and it will always be so.

PUBLIC HEALTH IN WARTIME

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A nation at war has to call on all its resources, and one of the sources of strength of a nation is the health of its people. This was my observation last year when I was in England during the trying period of intensive aerial bombing. Under conditions of war, England is paying particular attention to her public health, and there is much in her experience that we can profitably consider in this country, at this time.

The progress we have made in recent years in promoting the health of our public is one of the great achievements of our country. Public health is concerned not only with programs that prevent infectious diseases, such as diphtheria, whooping cough, tuberculosis, and typhoid fever, but public health is also concerned with efforts to improve our diet, our vision, and our mental as well as our general state of health. We have gone far in extending to our citizens the right that is theirs—the protection of life, the relief of suffering, and the prevention of disease.

Let us consider the organizations and persons that work together to promote public health in this country. There are of course the civil agencies, from local community to federal government, that function as authorized bodies to look after our many public health needs. Add to them the many technical persons and groups who gather information for the use of these agencies—scientific medicine, laboratory workers, investigators, engineers; these are the toilers who furnish the tools with which the public health administrator works. Then there are the unselfish volunteer lay organizations that do so much real good for all classes of people in all sorts of circumstances. The official as well as the unofficial agencies are being increasingly motivated by a social consciousness.

But the advances in public health have not been due entirely to these organiza-

tions with their technical backgrounds. They have been due in large part to the receptivity of the public, to its willingness and at times its demand for safeguards of its health, and to intelligent co-operation between the public and the health agencies. The strength of our public health plan lies in this combination of forces.

We, in these times, find ourselves at a high level of public health accomplishment. We have seen improvements we can actually measure, besides many benefits that are beyond the application of a yardstick. Infant and maternal mortality has been reduced. The acute diseases of childhood are not exacting the toll they once did. Physical examinations and corrections of defects in school children are commonplace. Eyes, teeth, and posture of young people are deservedly attracting attention and correction. Early immunization has almost eliminated diphtheria, and tuberculosis is at its lowest ebb. New drugs, better medical care, and early diagnosis have reduced the hazards of pneumonia, tuberculosis, blood poisoning, and child-bed fever. The industrial worker is being protected. Housing is improved year by year. We have kinds and quantities of food to an extent that we have never had before, and our children are taller and stronger than we were. More people are living to an advanced age, and our mortality rate is at the lowest in the history of our country.

This may look like a favorable situation—and so it is, but let us not congratulate ourselves too heartily! Victory is only partial and hangs on a narrow margin, for the forces of nature and the complexities of human life make our health situation constantly precarious. Our advances will be maintained only with ever-increasing vigilance, work and intelligent co-operation. We cannot afford to be complacent or self-satisfied, but must continue our upward progress, so that more may profit by our efforts, as we value human life and the right of "life, liberty and the pursuit of happiness."

We are now at war, and we are fighting for the essentials and principles of a democratic way of life. Insofar as public health is an expression of the democratic regard for the worth of the individual, we are fighting also for the principles of public health. I do not mean to say that the health of the public is not protected in the undemocratic nations. But there the life of the individual is preserved for his greater usefulness to the State. Here, we proceed on the basis that the person is what counts, so that it is our point of view regarding public health that we are striving to maintain. And this is another reason why just now we cannot afford to relax our vigilance over our national public health.

Then there is a third basis for our increased attention to our health—protection against the added strains and exposures of modern warfare. I am speaking primarily to civilians and to them I should say that a total war means total civilian participation in one way or another. We civilians need our good health so that we can do our daily jobs regularly and better. We want to preserve the health of ourselves and of our families so that cause for worry and distraction from our work will not come from illness in us or in our families. The industrial worker is to be protected as never before, in order that he may play his role in being "the man behind the man behind the gun." And because there are now sixteen men, and women, supplying each man at the front, the importance of the health and working power of the civilian is greatly magnified in this time of modern war.

We must protect the home front—if not against bombs and shells, then certainly against the unseen parasites, the harmful bacteria, that may do more damage than bombs. If we do this job well, then we are doing our part as civilians in the total war effort.

Having pointed out the progress we have made in public health and the reasons why we must extend and intensify our programs, let me refer to some of the specific factors that may threaten us as a civilian public, and to measures and agencies that we can call on to protect our public health.

We are fortunate in having a high standard of education and sense of personal responsibility. We as a people know a good deal about health matters, and this is a time where we can use what we know and be ready to learn more. For instance, we could gain so much by learning the basic principles of first-aid and by knowing what foods are essential for our well-being. And it would be well if we are on the alert for signs of ill health and then promptly put the case into the hands of medical or other authorities.

In our modern way of living in large or small communities and with our modern rapid means of transportation, epidemic diseases may quickly become a serious menace to large numbers of people. All the governmental agencies organized to recognize and meet such emergencies will be especially on the alert at these times, ready to attack a threat to our public health. We as individuals have an added responsibility to co-operate with authorized bodies of men and women who are working for our common good.

Immunization programs against diphtheria and smallpox are being emphasized. Although these programs are thoroughly justified in peacetime, they are of added importance for the preservation of life and health and for the removal of anxiety and confusion in wartime. And so with other programs in public health, as child and maternal welfare, dental care, clinics and medical care, the maintenance of our usual programs is to be insisted on, both by the public and by those already authorized to conduct them.

There may come a time when our food situation will not be as we are accustomed to, if that time is not already here. Not that we will suffer from lack of food, for we probably will not, but there may be certain kinds of food that will be limited in amount, and distribution may not be as effective as usual. We realize the importance of food in connection with our well-being and, as in the case of other health matters, we are an educated public willing to adapt ourselves to new circumstances; and if we find ourselves without a certain food we will be ready to restrict our diet or to use a substitute for the lacking item. Food science has progressed greatly in recent years, and we may rest assured that a scientific management of our food situation will go into effect if there comes a time when it appears necessary. Until then, we as civilians will follow the advice and choice we have, so as to maintain ourselves at the highest point of well-being to meet the added burdens of total war.

Our living in communities has caused the organization of certain services that we now consider essential. I am referring to our electric and gas utilities, water supplies, our milk and food distribution, and sewage disposal plants. The proper functioning of these services is an accepted principle. Since, however, confusion, want and perhaps epidemic disease would result if the services failed to function properly, we see them in their true light of importance. Their effective maintenance in times of war is an added responsibility for those persons and agencies charged with supplying them.

Under these critical circumstances that we face, it is not enough that we use only the information that we now have available. Our scientific knowledge is far from complete. We must continue to search and research, so that we will learn more of the secrets of Nature, and have this information ready to solve old problems and to meet new ones. Therefore, our research laboratories, our educational institutions, our investigators in the field, and men working in quiet places will work on and supply the information necessary for the emergency and for the permanent good of mankind.

The promotion of the public health is a real weapon in the struggle for our democratic principles. In the protection of the life and health of the individual, we are making it possible for him to enjoy the freedom of self-development. At this time he is fitting himself to serve himself and country to save the right to be free. Protection of his health gives him strength to meet new physical and mental demands, and prevention of illness in his family removes a source of worry and distraction.

It is clear from this brief discussion that public health in wartime has new significances. We cannot take for granted those advances we have been enjoying. We must maintain, intensify and extend our public health programs so that we may meet the new emergency with added strength and resources.

Up to now I have not mentioned a certain word that is in such wide use these days. It expresses an important factor in the will-to-do in our war effort. I refer to the powerful word, "morale."

Have I not been speaking of morale all the time? Do not the factors of health, food, safety, and confidence in responsible agencies all contribute to the sense of will? If we think of the disastrous physical and mental effects of illness, hunger, epidemics and disorganization, surely we can see that our outlook and morale depend on the precious possessions we now enjoy.

And for what purpose do we desire public health and morale? Certainly, so that we can effectively do our tasks in wartime; but let us look forward also, and hope that we will gain permanent advantages and that the democratic principle of the personal worth of the individual is won!

AGRICULTURE AND THE WAR

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Agriculture has been given the job in the national emergency of producing food for our armed forces, for our civilian population, and also in no small measure for our allies. The importance of this task has been expressed by Mr. Wickard, our national Secretary of Agriculture, in these words, "Food will win the war and write the peace."

How different the situation today from a few years ago when agriculture was suffering from an over production of crops. The loss or severe contraction of the export demand had resulted in great excess stocks of certain commodities, including cotton, wheat, tobacco, rice, and certain livestock products. Prices for farm products dropped according, so that in 1932 the gross farm income was less than half of that of 1929, while fixed charges, including interest and taxes, were not proportionately lower. In the following years, through the co-operation of the farmer and the government it has been possible to cut down on the surplus production of crops through reduction in acreage, to increase the production of soil conserving crops at the expense of soil depleting crops, and to work out procedures for the orderly marketing of crops, with a net result of an increase in the farmer's income.

To meet the needs for 1942, goals in crop production have been set. The greatest increase is in crops to supply vegetable oils, more than half of which have in the past come from the far east. The production of soybeans has been set at 154 per cent of that for 1941, peanuts—155 per cent, and flaxseed —134 per cent. Production goals for livestock products include milk—107 per cent of the 1941 production, hogs for slaughter —114 per cent, cattle and calves—108 per cent, eggs—113 per cent, and chickens —110 per cent. To give this production there will be needed an increase in food crops. This means more corn, more hay and more pasture. Also more vegetable crops will be needed. The production of tomatoes for canning has been set at 118 per cent, and peas —132 per cent. More vegetables for home consumption, both fresh and canned, will be required. It

should be noted that there is no call for increases in staple crops like wheat and cotton, because of the present surplus.

This gives some idea of the job which has been given agriculture for 1942. In attaining these goals certain limiting conditions enter into the situation.

The supply of farm labor is one of the limiting factors in crop production. This is especially acute in industrial areas where there has been a great movement from the country into industry. Moreover, many farm boys are now with our military forces.

The production of farm machinery will be curtailed. New equipment for 1942 has been limited to an average of 83 per cent of that produced in 1940, although repair parts may be produced up to 150 per cent of the 1940 production. Old machinery must be made usable by attention to repairs.

Fertilizers, which can aid in increased production, will be available in limited amounts. Fortunately, the supply of mixed fertilizers available for the spring planting in 1942 is slightly above that for 1941. The greatest deficiency in fertilizer materials will be in nitrogen fertilizers, as the munitions industry is making heavy demands on our nitrogen supply. The production of superphosphate will be limited by the amount of sulphuric acid available for treating the rock phosphate. This acid is used in numerous other essential industries. The domestic production of potash is ample for our needs. The supply of burlap for ferlizer bags is very limited. Great quantities have been ear-marked for use in sand bags and for other war purposes. It is reported that sufficient paper bags have been allocated to the fertilizer industry to make up for the shortage, at least for the present.

In achieving the goals set for Agriculture in 1942, it is highly important that they be attained without impairing the productivity of the soil, since there is every prospect that the needs for 1943 will be even greater than the high production goals set for 1942, with a progressive rise from year by year throughout the emergency. Also for the post war period need for these products will inevitably follow.

To attain the needed production, in spite of the limited supply of labor, of machinery, and of fertilizer, it will be necessary to utilize to the fullest home developed plans to make use of the farm resources. Attention must be given to the selection of adapted seed of the best varieties and hybrids available, to timeliness in planting and harvesting, and to improved tilth through careful tillage. The production of better forage, soil improving and pasture crops will require in many cases a greater use of lime. While the application of lime has been on the increase in Ohio during recent years, the total amount used to date is still far short of that which could be used profitably. Forage and pasture crops are of first importance in the production of livestock and livestock products. Legume crops, grown on fertilized and limed land, will be high in protein content, and will supply a large amount of calcium and other minerals needed in livestock feeding rations. Moreover, the production of better legume crops will result in the addition to the soil of more organic matter, and the nitrogen supply will be increased, thus offsetting the shortage of fertilizer nitrogen.

By the proper care and use of farm manure, its full value in crop production can be realized. Too often one third or more of its value is lost by improper handling—largely as the result of leaching away of its valuable constituents.

Soil erosion must be kept at a minimum. Any change in the cropping system which might result in needless soil erosion should be avoided, and means for the control of erosion should be continued and strengthened.

Another means for increased production might seem to be in an increase in total cropped acres. This method was followed in 1917 and after, and led to a serious increase in soil erosion and soil deterioration. This came about primarily through the use of land for unadapted purposes. Such use will certainly result in low yields for the present, and soil destruction for the future. Increased crop

production secured in this way, will be at a high acre cost, and with a use of labor all out of proportion to the returns received. In the present emergency this is to be avoided if it is at all possible. The mistakes of the past must not be repeated.

Only by the use of measures which will insure maximum efficiency in production, and at the same time conserve and build the soil resources, will it be possible to produce the needed supplies of food. There is nothing radically new in this program for Agriculture. Only time tested means for insuring maximum, economical production for this year and the years ahead are suggested. To this end the American farmer can be counted on to do his part, even though it may take long hours to get the necessary work done.

CONSERVATION IN TIME OF WAR

PAUL B. SEARS

Man does not live by material things alone, but he cannot live without them. Natural resources are the instruments of war and peace alike. The human spirit cannot, whether in peril or in safety, come to its flowering unless nourished and supported by material substance.

One shot from a large-caliber gun requires a bale of cotton or its equivalent. Sometimes this represents a year of effort for a farm family. The manufacture of sufficient explosive for such a round of ammunition requires somewhat more alcohol than can be produced from three hundred pounds of sugar. A man who had the income from the price of a good bomber could retire and live in considerable comfort. The tires for one type of modern tank require enough rubber to supply sixty peacetime automobiles. Only four of our greatest universities have sufficient endowment to pay the cost of a single, first-class modern battleship. Oberlin might perhaps be turned into a modest small cruiser.

We have all heard such facts, and many more like them, during the past two decades. We have been told these things to remind us that war is evil, which we all know anyhow. But we have also been told these things by those who wished to see the United States unprepared when war came. It is a doubtful enough expedient with children to tell them to stay away from evil and ignore it. With responsible adults such counsel is itself evil. Adult individuals, like adult nations, have to face issues and cope with them as well as they can.

Now we are moving into the thick of battle, and we have no choice, whatever the cost, but to see it through. We have to learn, the hard way, that war is the certain fruit of rotten and slovenly peace. Unless we win, at whatever sacrifice of wealth and lives, nothing we own will do us much good. Worse, we shall have lost the freedom and self-respect which mean more than wealth or comfort. Whenever any nation comes to feel that nothing whatever is more important than remaining alive and physically comfortable, then that nation does not deserve to remain alive. It has become a sort of human sty whose inmates chough brutishly at their troughs, oblivious of the coming slaughter.

War strips the human character to its essentials, revealing the best and the worst. Courage, loyalty, and steadfastness are the prime virtues of war, as of peace. But character barehanded cannot win a war, any more than character without equipment can build decent communities and homes in peace time. The human brain is helpless unless human hands have the stuff to work with. We need materials. We consist of material stuff. Every breath we draw is literally an interchange of our own materials with those of the atmosphere. This ocean of air, with the earth beneath our feet, and the water which permeates both, are the

reservoirs out of which all of us, from Michael Angelo to Weary Willy, are organized. If you think I exaggerate the importance of material things, try putting yourself on a diet which has no vitamins in it, and see what happens to your spiritual qualities in about three weeks—if you can trust your judgment at the end of that time.

We cannot respect ourselves unless we respect the materials which make our existence possible. The first sign of disintegrating character is often to be found in the material things about an individual. Where there is contempt for material things there is likely to be contempt for human beings.

Americans are often accused of paying too much attention to material things. We are skillful in producing them, no doubt of that, and we enjoy having them. But I do not believe that we worship them. We do not even respect them as we should. We let them get in our way, and we waste them. One of my friends complained that he could never get down cellar because of the stack of broken vacuum cleaners, mixers, floor lamps and toasters which filled the basement entrance. During the first World War, the thrifty French were appalled at the extravagance of Americans with their equipment. As I recall it, one French balloon company was able to maintain its gear in good condition on what a nearby American outfit discarded. If we are going to win this war, and if we are going to have enough left over for a decent civilization when it is finished, we must change our way of thinking about things, and about the materials from which they are made.

We are pitted against an enemy whose resources do not equal our own. He has prepared for this war, to date mainly successful, on a scale not less than heroic. In this stupendous preparation two very different things have been involved. We must be careful not to confuse them. One is ruthless and beastly oppression. We hate it, and want none of it. The other is the massive folk-strength of the German and Japanese people, now so sadly perverted. At its best, this folk-strength, with its scrupulous respect for material things, thrift in their use, and wise thought for the future, is something we ourselves very much need.

Until 1900, Germany taught the world science, and Japan was her readiest pupil. We too, learned much from the Germans. At no time have we been slow to use scientific knowledge in the actual production of goods, and in that respect we have equalled or surpassed our two leading enemy nations.

In one great and costly respect, however, we have failed. We have used science freely when we could see the chance to make it pay returns here and now. We have not used it to safeguard a future permanent supply of raw materials. Getting immediate profits is always somebody's business. Looking out for the future is everybody's business. The chemist's advice has been eagerly sought and well paid for on production problems. His warnings about building up a war-reserve of rubber and tin were not heeded. In his former role he is the equal and confidant of men of affairs; in the latter, when he attempts to advise on public policy, he is like a child waving at an express train. Our criminal negligence in matters beyond the realm of immediate financial return is one of our worst faults and has made us exceedingly vulnerable.

In 1891 a young American about to enter the steel business was in Germany training himself as a metallurgist. In the course of his travels he came to Essen, where the great Krupp works were located. This was the Pittsburgh of Germany. His attention was particularly attracted by the river which flowed through the city, right past the zone of heavy industry. This stream was as pure and clear below as above the city. Mindful of the once-beautiful streams of his native Ohio, which were by that time foul open sewers, full of poisonous waste, he complimented his German hosts. "Why," was the reply, "we could not afford to have it otherwise. We have seen the streams in the United States, and we cannot understand why you permit such things to happen."

The God of War has an insatiable appetite, not only for the lives of men, but for the physical resources essential to existence. The Civil War left the southern states gutted, physically as well as spiritually. Soon after the time of Charlemagne, Europe was stripped of its forests, save for the hunting preserves of the great. This devastation was accomplished, less to furnish timbers for the arts of peace than to furnish charcoal for the steel which was the instrument of conquest. The First World War made tragic inroads upon our soil and our forests. Today, in Ohio and throughout the nation, the privately owned woodlots and forests are being wastefully slashed to the ground. Cherry and hard maple are being used for charcoal. Fine ash, much needed for handles and for the ribs of airplane tanks, is being used for mine-props; white oak, essential to shipbuilding, is being cut for use in smelters. And we have the assurance of the Chief Forester of the United States, in his last report, that this is not only wrong but wholly unnecessary. No wonder that he sees no hope save in vastly extended government ownership and severe regulation of private operations. The grave of private ownership is being dug, not by Marx and Lenin, but by those who refuse to accept the responsibilities, along with the privileges, of private ownership.

I happen to believe in private ownership, for to me it represents a hard-won human right. It seems idle to talk of human versus property rights without being more specific. During thirty years of work at my profession, I have been able to accumulate very little private property. Recently, thanks to the thrift and good fortune of others, I have come to be the custodian of some private property. This much I see clearly about it. Its value to me, and through taxes to the community, is in direct proportion to the conscientious stewardship that has been given to it. The moment that such stewardship ceases, it will become a liability to its present custodian and to the community.

No matter how you magnify or diminish the scale of operations, in war or in peace, this same principle holds. The destiny of man, in any sense that I can understand it, is inextricably twined into that of the material world around him. It makes little difference to what material resource one turns for illustration.

The chain of stewardship may be long, and consequences remote. Or the reverse may be true. In either case the chain is continuous and effect follows cause. Today's dispatches contain the seemingly insignificant governmental announcement that bee-keeper's supplies have been given a high priority rating, indicating that they are important in the prosecution of war. At first guess this would seem to be due to the fact that honey is an important substitute for sugar. Actually beeswax, in whose production the bees use 14 pounds of honey to make one of wax, is far more essential. On the average, every defense machine requires ten pounds of beeswax, for which there is no substitute save materials produced in the Malay region and not now available.

But the most vital importance of fostering the bee industry lies in its relation to the nitrogen supply. Nitrogen is an indispensable part of fertile soil, for without it there could be no protein foods to replace the wear and tear of living. Nitrogen is equally essential in the manufacture of explosives, not to mention dyes and plastics. Modern war is insatiable in its demands for nitrogen and will take all it can get.

Unless fertilized, poor soil shows nitrogen deficiency the first year, and the best of soils in three years. Now clover is a prime means of restoring nitrogen to the soil. On its roots live bacteria which can turn the trick by taking nitrogen from the air and fixing it into usable form. Clover is a potent substitute for the electric furnace and for expensive nitrate minerals, releasing them for war time use.

But clover must be grown from seed and the successful production of clover seed has proved to be one of the costliest, trickiest operations on the farm. The stuff may sell for $12 to $25 a bushel, because the crop is erratic. This is so because the distribution of honey-bees is erratic. Seed only forms when there are bees to

pollinate the plants. A good collection of bees can insure pollination on a hundred square miles of farm.

Why, then, are there not plenty of bees on our farms? The answer lies largely in a single word—carelessness. Bees are subject to a fatal infection known as foul brood. This is carried by bees who rob diseased hives of their honey. Robbing is a habit, largely preventable. The honey left in hives dead from foul brood should be promptly destroyed and the hive fumigated. The state employs inspectors who will do this without cost. But these inspectors are helpless and the most carefully managed apiaries constantly in danger because many bee-keepers will not take the trouble to report dead hives or attend to them personally. With co-operation, this disease could be stamped out in a year or two. No man, not even a whiskered hermit bee-keeper, liveth unto himself. The chain of stewardship may be long, but it is unbroken.

Water is a more obvious and spectacular resource than the honey-bee. Unending is its majestic round from sea to cloud, down to earth and back to sea. For us the precious phase of this cycle lies between raindrop and ocean. We and all our works are maintained by rain and snowfall on its deliberate course back to the ocean. In proportion as this movement is leisurely, water finds expression in life and industry. When this movement is unregulated, life is scorched, industry thwarted, and the very earth stripped bare by rushing flood.

Today the expanison of war industries is definitely limited by available water supply. The Youngstown area, home of Little Steel, cannot increase its production without more water. Each ton of steel requires some three hundred tons of water. There is plenty of rainfall, but bare hillsides and farms that have been wrongly handled will not hold it. Floods in the Ohio area are three times as frequent since 1900 as before. This flood water is needed desperately on farm and in factory, and by proper land use could be retained. Without such land use, even reservoirs are no good, for they soon wash full of farm soil.

Our proud highway system contributes to this famine. Each is a watercourse built without any thought save to get the water away and into rivers as fast as possible. Here again the chain of stewardship is long, but this chain leads in the end to our giant smithies which forge the arms of war and the instruments of peace.

Recently I sat with a small group of experts on various types of natural resources. The meeting was completely unofficial and all came at their own expense. Formalities were done away with and every one got down to brass tacks. Each man was asked to give the immediate practical obstacles to proper conservation in his own field in the state of Ohio.

We found that defects in the state civil service system kept the public from being as well served as is business or several neighbor states. We found that the budgets for research and protection of public health were pitiful beside those customarily allowed by business for the same purposes. But to our comfort we found that no one thought the remedy lay finally in either legislation or money—the two sovereign American remedies for everything from alcoholism to foreign relations.

The core of the business lies in education—of leaders, of average adult citizens, and of school children. And the end of this education lies, not in fostering bureaucratic control and vast public enterprise, but in helping individuals and local communities to help themselves.

For conservation, when all is said and done, whether in war or in peace, is not a scientific trick or a police job. It is a way of living. It must be in the air. It must be an article of faith which looks on material things with the respect and jealousy which they deserve—not as ends, but as essential, inviolable means to survival and beyond that to the good life.

RELATION OF DOMESTIC SEWAGE TO STREAM PRODUCTIVITY[1]

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Food is one of the first requirements of all living things and is often the limiting factor in the establishment and maintenance of a species. Animals depend directly or indirectly upon green plants for their food. A stream may be considered as a nutrient medium, more or less adequately balanced, thus supporting the organisms living in it. The kind and number of organisms supported depends, in addition to food materials, upon factors such as the condition of the water, current, temperatures, pH, suspended solids, dissolved oxygen and carbon dioxide. A body of water well supplied with all the essential mineral elements in proper form and concentration, with optimum conditions of temperature, pH, etc., will naturally support the largest population of organisms. A stream may have optimum conditions for the development of a certain species, resulting in a rapid increase in numbers of that species, with the exclusion of other forms developing the well-known "bloom" of nearly pure culture. This optimum condition may last for only a short time and the bloom quickly disappears. On the other hand, a stream lacking or deficient in one or more of the essential mineral elements will be largely barren of aquatic organisms.

Data from a biological survey of the Ohio River Basin (1939–1940) (1) indicate that in general the barren streams are found south of the Ohio River in regions where the soil is poor in humus, the farms are large and scattered, and few cities or larger towns are located along the streams. It seems probable that these streams may be deficient in some essential mineral or minerals which would account for the low phytoplankton population, and subsequently for the low fish population.

These streams are probably adequately supplied with those salts which can be dissolved from the rocks and soils over which they flow but may be deficient in minerals, possibly nitrates, that could be added by decayed vegetation, domestic sewage and barnyard manure. Owing to the poor soils, the streams in this region, as the soils, are not productive. The streams in the northern sections flow through regions of high soil fertility and dense human population. These streams support a much higher plankton population than the southern streams.

In order to determine the effect of domestic sewage on stream productivity, a study was made on several streams where there is known to be definite sources of pollution and also on streams that are comparatively clean. The Miami, Little Miami, Wabash, and its principal tributary, the White, all flow through industrialized areas and are heavily polluted by domestic sewage from scattered towns and cities in the watershed. The Big Sandy, Guyandot, Licking and Green Rivers are examples of cleaner streams. They flow through a sparsely settled region of poor soils and only a few small cities or towns are located in these areas.

METHOD AND PROCEDURE

The samples for plankton studies were collected in 250 ml. glass stoppered bottles. The samples were studied in the fresh condition or were preserved in 3% formalin. One hundred milliliters of the sample were centrifuged for five minutes at a speed of about 2,500 r. p. m. The organisms in a known amount of the "catch" were counted and the number in one milliliter of the original sample was computed (2). The volume figures, expressed in parts per million (p. p. m.), were obtained

[1]Published by permission of the Surgeon-General.

by multiplying the number of individuals of each species by the average volume of that species and adding the total volume of all species.

RESULTS

The Miami River flows through a densely populated industrialized area in Ohio, and the stretch of the river below Dayton receives domestic sewage and industrial wastes from the following cities: Hamilton (sewered population 54,000), Middletown (pop. 35,000), Franklin (pop. 2,700), and Miamisburg (pop. 5,300). Samples taken at stations above and below these towns, from May to December, 1939, show that the plankton volume is generally high, ranging from 3000 to 8000 p. p. m. The plankton volume near the mouth at Cleves was high (8000 p. p. m.) in May, due mainly to diatoms and large numbers of *Cryptomonas erosa* and *Chlamydomonas*. During the low water period, from July to October, the plankton volume was around 4000 p. p. m., reaching a maximum of 10,000 p. p. m. on August 28; diatoms, Chlorophyceae and Euglenophyceae forming the bulk of the algae. The advent of cold weather (12° or less) after the middle of October reduced the volume to less than 1500 p. p. m.

The sewage from Hamilton tends to increase the volume of river plankton. The total algae below town is usually higher than 4000 p. p. m. with a maximum of 16,000 p. p. m. in August. The plankton population is depressed below Middletown, probably due to the heavy load of industrial waste from the paper mills. Below Franklin the total volume was above 3000 p. p. m. during the summer and reached a peak of 22,000 p. p. m. on August 17. Euglenophyceae, Chlorophyceae and diatoms predominated. The plankton drops immediately below Miamisburg, which may be due to the industrial pollution from paper mills and a tobacco plant, and the smallness of the stream in this region.

Samples taken above Dayton, at Tippecanoe City, Troy, Piqua and Sidney, show a variable plankton population which may be due to the various sewage treatment plants, heavy industrial loads and the small size of the stream. However, only one series of samples was taken in September. The total plankton volume of the stream showed a slight rise from 4800 to 6500 p. p. m. below Tippecanoe City, and a slight drop, from 4800 to 2800 p. p. m. below Troy.

The Little Miami River and its tributaries are polluted locally by several small cities in the watershed. The total volume of plankton was somewhat less (2000—6000 p. p. m.) than in the Miami River, except during the low water period in late summer. The plankton usually dropped below South Lebanon, followed by a gradual rise to the mouth at Beechmont, due to the fertilizing effects of the sewage from Kings Mills, Loveland and Milford. During the week of September 22, a bloom of *Pandorina* and *Chlamydomonas* occurred below the mouth of Yellow Springs Creek, which may be due to the heavy pollution load from Yellow Springs and optimum conditions of temperature and stream flow.

Batavia and Williamsburg discharge a small amount of untreated sewage into the East Fork, which is insufficient to cause any marked effect on the plankton.

The Wabash Basin lies largely in the State of Indiana and a small portion of Illinois. The river is locally heavily polluted by several large cities. The plankton population is large, and consists of many species. Below Peru a heavy growth of algae appear along the banks of the river, and the plankton volume is generally high, varying from 14,000 p. p. m. on August 1 to 3000 p. p. m. on September 3. Below Logansport there is found a region of intense pollution which extends downstream for a considerable distance. The bottom and sides of the channel are covered with a growth of attached protozoa and fungus common to extremely polluted regions. The plankton volume is low, less than 2000 p. p. m. The fish are relatively scarce—suckers, shiners and a few carp constituted the catch. The peak of the plankton, due to the fertilizing effect of the Logansport pollution, occurs in

the region of Delphi, some twenty miles downstream, where the volume reached 58,000 p. p. m. on September 6. Here the fish were plentiful and varied. Smallmouth and white bass, common and redhorse suckers, mooneyes, yellow and channel catfish, longeared sunfish, darters and shiners were caught. From Delphi, the plankton population drops off until the influence of the Lafayette effluent is felt in the vicinity of Independence. Above Lafayette smallmouth bass were common, while sunfish, shiners and darters were quite plentiful. Below Lafayette bass were absent but gar pike, channel catfish, mudcats, shiners, darters and sunfish were common. Fish were plentiful along the stream to Terre Haute.

Terre Haute is another source of heavy pollution. In addition to the untreated sewage there are numerous commercial plants that pour their wastes into the river. At this point the current is swift so the pollutants are distributed for many miles downstream. Owing to the strong current and wide distribution of the wastes, the fertilization effect on the plants is not localized to the point of producing a prominent peak in the plankton volume, as is often the case. The total plankton volume is about 2000 p. p. m. From Meron Ferry downstream, the plankton gradually decreases to the mouth, with slight rises at Parton and below the junction of the White and Patoka Rivers. In contrast to upstream conditions, no fish at all were taken below Terre Haute. Ten miles below Terre Haute the natives reported that suckers were common; sunfish, shiners and mooneyes were also present. From here to the mouth of the Wabash, the fish were plentiful and varied.

The White River is subject to heavy pollution for almost its entire course. The pollution immediately below Muncie, Indiana, is so intense that the phytoplankton population is almost entirely destroyed. It is likely that some ciliates exist in these conditions, but as the samples from this location had been preserved in formalin, and the protozoa do not preserve well, they did not show up in the plankton samples. Recovery is rapid but the plankton volume reached its peak above Nobleville (total volume 36,000 p. p. m.). The plankton volume fell below Nobleville and decreased greatly (total volume less than 2000 p. p. m.) above Indianapolis, until Martinsville was reached. Below Martinsville conditions were favorable for the proliferation in large numbers of diatoms, especially *Stephanodiscus* and *Synedra*. This diatom population continued on downstream past the mouth of the Eel River to Newberry where, possibly due to the diluting effect of this tributary, the total volume fell off. At Washington most of the diatoms had vanished, green flagellates appeared under the influence of fresh pollution. From this point downstream the total plankton fell off to approximately 1500 p. p. m. above the mouth.

The fish population above Indianapolis at Perkinsville, Strawtown, Noblesville and Nora is varied and quite plentiful, consisting of basses, buffalo, carp, bluegills and crappies. Below Indianapolis some sunfish and buffalo were caught and local fishermen reported that carp and catfish were also present. At Martinsville common and quillback suckers, hogmollies, sunfish and numbers of minnows were taken in the seine. From Spencer to the mouth fishing was generally good, the catch consisting of a mixed population.

In comparison with the above streams, the Licking, Big Sandy, Kanawha, Guyandot and Green are clean rivers. For the most part they flow through sparsely populated territory and the soils are poor in organic matter. The plankton population as a whole is low, maintaining a level of less than 2000 p. p. m. for the entire watershed during the summer. In a few cases, such as below Paris and Cynthiana, the volume rose to slightly higher figures.

DISCUSSION

Raw sewage which enters streams from city sewers or organic industrial wastes affects aquatic organisms in a variety of ways. The waste may have an immediate

toxic effect, or it may induce rapid multiplication of aerobic bacteria which sharply lower the dissolved oxygen concentration, frequently to the asphyxial level for fishes, and sometimes to depletion. This latter is probably the most frequent cause of mass death of fishes in the streams of the Ohio Basin. This toxic zone is evident for a variable distance below the sources of pollution, depending upon temperature, rate of flow and type of stream. This region has a low plankton population. The fish are few and principally of the rough species, such as carp and buffalo. Fungi and stalked ciliates may be attached to solid surfaces.

Further down, the polluted stream is characterized by a large variety and volume of photosynthetic algae. The large population of plankton furnish fish food and in this region is usually found a large mixed fish population. This increase in aquatic organisms is probably due to the addition of available plant food materials (nitrates and phosphates) derived, by bacterial action, from the raw sewage introduced upstream. This is the region that shows to a marked degree the beneficial effects of the fertilizing value of the upstream sewage. Further downstream the phytoplankton population rapidly decreases.

Observations made below towns with various sewage treatment plants indicate that when the sewage receives secondary treatment so that the reduction of the complex compounds to available plant food materials by bacterial action takes place before the waste enters the stream, the early obnoxious conditions may never occur. Thus, the stream may be benefitted for much of its course and organic wastes become an asset to a stream instead of a liability.

Streams that do not receive organic material from some source, either natural, such as decayed leaves, dead organisms, or washings from rich (humus) soil or from sewage, are low in plankton population and, therefore, do not support a large fish population. Leaves and other vegetation are composed largely of cellulose and decompose slowly, while domestic sewage, which has been subjected to enzymes and bacterial action in the human body, is quickly converted into available salts after entering the stream.

SUMMARY AND CONCLUSIONS

A study of the relation of domestic sewage to stream productivity was made by comparing the aquatic population of heavily polluted and clean streams in the Ohio River Basin. The Miami, Little Miami, Wabash and White Rivers were selected as examples of heavily polluted streams, and the Licking, Big Sandy, Guyandot and Green Rivers are comparatively free from polllution.

Raw domestic sewage in high concentrations is decidedly detrimental to phytoplankton and most species of fish, either by direct toxicity or to a reduction in the dissolved oxygen by bacterial action. Further downstream, where the sewage has been reduced to available minerals by bacterial and chemical action, the phytoplankton responds to the fertilizing effect of the sewage by a tremendous increase in numbers and species. The phytoplankton furnishes food for the zooplankton which, in turn, is reflected in the increase in the population of mixed fishes. This is the region where the stream clearly shows the beneficial effect of upstream organic pollution. Further downstream the plankton volume decreases, and a comparative few genera persist. This region is characterized by a reduction of the forage and rough fishes and a relative increase in the game fish. As further purification occurs, there is a disappearance of plankton and a corresponding reduction in fish numbers and species.

Proper sewage treatment plants will largely eliminate the early toxic region and the stream will be made more productive by the fertilizing effect of domestic sewage.

REFERENCE

(1) **Floyd J. Brinley** and **L. I. Katzin,** U. S. Public Health Service Bulletin, in press.

BOOK NOTICES

General Entomology

This text treats the subject from the viewpoint of ecology. Although it is general innature and attempts to cover all phases of the subject, there is a minimum of discussion on such subjects as identification, classification, physiology, morphology, economics, and control, and a greater emphasis on the habits, habitats, and ecology of insects.

The introductory chapters of the book deal with the place of insects in the animal kingdom, the relation of insects to man, the orders of insects, and the morphology and metamorphosis of insects; the major part of the book is concerned with the ecological aspects of entomology. There are chapters on the distribution, abundance, reproductive capacity, color, sonification, and behavior of insects, insect associations, scavengers, predators, and parasites, associations of plants and insects, leaf-mining, leaf-rolling, gall, boring, subterranean, aquatic, and case-making insects, etc. Some of these subjects (e. g., the fecula of insects, leaf-rolling insects, subterranean insects, and case-making insects) are not ordinarily treated in a general entomology text.

The chapter on insect orders includes a key to adults; the appendix includes keys to the larger groups of immature insects (orders, and the more common groups of lepidopterous and coleopterous larvae), and additional material considered too technical for the text.

The discussion is well written, up-to-date, and well illustrated. At the end of each chapter is a list of carefully selected references. With the discussion emphasizing habits and habitats, an effort is made to train the student to make observations in the field, and to study living material whenever possible rather than pinned specimens. A phase of the subject not treated, which might be appropriate in a text of this sort, is that of the various laboratory and field projects suitable for beginning students (e. g., methods of collecting and rearing insects). This point is briefly mentioned in the preface, but the text contains no detailed discussion or bibliographic references on it.

A course in general entomology based on this text would be a very broad one, designed to awaken interest by a study of living animals. The field of entomology would profit by the teaching or more beginning courses patterned after this text.—*D. J. Borror.*

General Entomology, by S. W. Frost. x+524 pp. McGraw-Hill Book Company, Inc., New York. 1942. $4.00.

Crop Ecology

Professor Klages of the University of Idaho has produced a useful text in a field not already overcrowded. His work is divided into four parts: the social environment of crop plants, the physiological environment of crop plants, the ecological factors, and the geographical distribution of crop plants. Parts one and two each contain five chapters, parts three and four, eleven chapters each. The maps in the text which form an essential part of it are from the numerous sources of U. S. Department of Agriculture publications. Each chapter has an extensive bibliography of recent literature, indicating the breadth of reading suggested for the aspiring student. The preface states, "no claim is made for the complete exhaustion of the available literature, and no doubt many contributions of distinct value and with a distinct bearing on the subject in hand have not been included in the discussion presented." With this statement the general reader is likely to be in full accord. There exists, however, the possibility of Professor Klages being taken to task by disappointed specialists in cognate fields for certain omissions. The agronomists working with crop subjects will find the book highly satisfactory, the soil agronomists may find a single chapter on edaphics too scant to review. The foresters and horticulturalists may resent the assumption that the word "crop" as used in this book excludes their harvests. The ecologists working with climate and climatic factors should be pleased with the full discussions. However, many ecologists may protest the assumption that habitat and environment are interchangeable terms. Economists and geographers will miss the mention of rubber and coffee in view of their wide use and value. Other minor items imported into the United States may also be missed. The geneticists, however, seem to be the most nearly forgotten men.

No one book can have everything. This is a good job and deserves recognition. It is a straightforward attempt to compress between two covers the many fields included in the subject as the author defines it.—*A. E. Waller.*

Ecological Crop Geography, by K. H. W. Klages. MacMillan Company, New York, 1942. 615 pages, maps in text + sviii. $4.50.

Temperature, Evolution, Development

This volume of Biological Symposia contains the papers delivered at three recent symposia of the A. A. A. S. The first of these on Temperature and Evolution contains eight papers, one each by Plough, Fankhauser, Child, Witschi, Muller, Landauer, Kinsey, and Moore, in which

many aspects of the relationship of thermal changes to character appearance, expression, and perpetuation are considered. The second symposium is upon the increasingly important subject of Isolating Mechanisms, with particular reference to their role in the evolution of the most completely studied plant and animal species. Stebbins, Blair, Kinsey, and Patterson participated. The third symposium deals with the Genetic Control of Embryonic Development, with illustrative examples chosen from Amphibia, the chick, and the guinea pig by Twitty, Hamburger, and Wright, respectively. There is a general integrating introduction to the series by Th. Dobzhansky.—*E. L. Green*

Biological Symposia, Volume VI, edited by Th. Dobzhansky. 355 pp. The Jaques Cattell Press, Lancaster, Pa., 1942. $3.50.

Botanical Microtechnique

Techniques for the preparation of plant tissues for microscopical study are invaluable to many botanists occupied in teaching and research. This book has been written as an elementary laboratory manual for beginning courses in plant microtechnique. A short chapter on collecting and subdividing plant materials to be processed should enable students to start the processing with excellent material. If plant tissues are poorly selected and crudely subdivided and otherwise handled carelessly, even the best procedures in processing result only in failure. Several methods of killing, fixing, storing, dehydrating, infiltrating, embedding, sectioning and staining of paraffin infiltrated tissues are presented. Two chapters on the celloidin method will be welcomed by a good many workers. Methods of sectioning unembedded tissues should be of service to the beginner. In this discussion chemical tests are given for several common plant substances. Whole mount preparations suitable for many plant materials are discussed. Only two short paragraphs give information concerning preparations of bacteria. Sixteen excellent photomicrographs are included in a discussion on criteria of successful processing. In part II about fifty pages deal with specific methods applying to various plants representing the larger divisions of the plant kingdom. A chapter on construction, use and care of the microscope will be found valuable to all students interested in microtechnique. No literature is cited except after the short chapter on photomicrography.—*G. W. B.*

Elements of Botanical Microtechnique, by John E. Sass; 222 pp. McGraw-Hill Book Company, New York. 1940. $2.50.

Biochemistry

Volume V of this series consists of fifteen review papers by specialists in their various fields. The subjects covered are indicated best by the table of contents which follows:

I. Symposium of Comparative Biochemistry.
   End Products of Nitrogen Metabolism in Plants. (Herbert B. Vickery.)
   End Products of Nitrogen Metabolism in Animals. (H. B. Lewis.)
   Merging of Growth Factors and Vitamins. (W. H. Peterson.)

II. Symposium of the Intermediate Metabolism of Fats.
   The Oxidation of Branched-Chain Fatty Acids. (H. E. Carter.)
   The Origin and Regulation of Ketone Bodies from Fats. (Samuel Soskin and R. Levine.)
   The Anabolism and Function of the Phospholipids. (R. G. Sinclair.)
   The Formation of Animal Body Fat. (H. E. Longenecker.)

III. Symposium on Carbohydrate Metabolism.
   Oxidation Catalysts. (T. R. Hogniss.)
   Phosphorylation of Glycogen and Glucose. (C. F. Cori.)
   Oxidoreductions in Carbohydrate Breakdown. (C. Meyerhof.)
   Pyruvate Oxidation and the Citric Acid Cycle. (E. A. Evans, Jr.)

IV. Symposium on the Biochemistry of Choline.
   Choline, the B Vitamins and Fat Metabolism. (E. W. McHenry).
   The Relation of Choline to the Kidneys. (W. H. Griffith.)
   The Nature and Significance of Choline Esterase.
   Interrelationships between Choline and Other Methylated Compounds. (V. du Vigneaud.)

Biological Symposia. Vol. V. Comparative Biochemistry. Intermediate Metabolism of Fats. Carbohydrate Metabolism. Biochemistry of Choline. Edited by Howard B. Lewis. The Jaques Cattell Press, Lancaster, Pa., 1941. $3.00.

—*J. B. Brown.*